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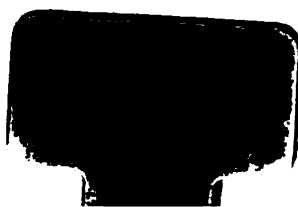
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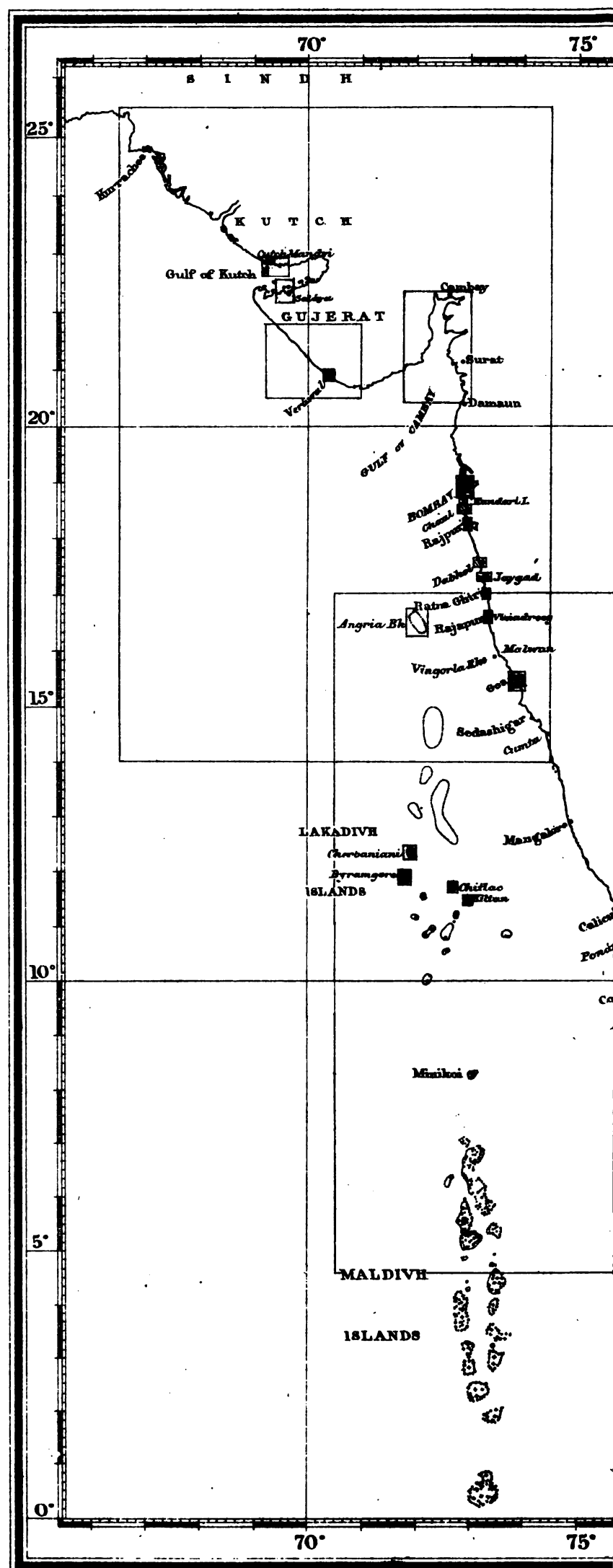












Drawn by Rajendrar Nauth Pillai, under the direction of R.C. Carrington, F.R.A.S. Marine Survey

# GENERAL REPORT

ON THE OPERATIONS OF

## The Marine Survey of India,

FOR THE YEAR

1878-79.

PREPARED FOR SUBMISSION TO THE GOVERNMENT OF INDIA

BY

COMMANDER A. DUNDAS TAYLOR (LATE I. N.), F.R.G.S.,

SUPERINTENDENT OF MARINE SURVEYS.



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# GENERAL REPORT

ON THE OPERATIONS OF

## The Marine Survey of India,

FOR THE SEASON

1878-79.

*Dated Calcutta, the 1st January 1880.*

### SECTION I.

#### GENERAL REPORT.

I have the honour to submit, for the information of the Government of India, my Report of the proceedings of the Marine Survey Department during the season under review. In paragraph 11 of the Resolution\* of the Government of India in the late Department of Revenue, Agriculture and Commerce, I was instructed in future to prepare the Reports of the Marine Survey Department for the survey-year, which is usually reckoned from the 1st October (when the cold season is commencing in most parts of India, and the Surveyors are again taking the field, after having completed the charts, sailing directions, &c., which were connected with the previous surveying season) to the 30th September of the following year.

\* No. 64, dated the 8th March 1879.

2. In order that the Government of India may be furnished with a complete account of what has actually been done in this Department since the publication of the last Report (which embraced the period known as the official year) and in accordance with the wishes of Government, the present Report embraces a period of eighteen months, extending from the 1st April 1878 to the 30th September 1879.

3. I consider it advisable to state, for facility of reference, the plan followed in reviewing the present season's work. I purpose to mention, *first*, remarks on my inspection of several harbours of India in company with Colonel Thomason, R.E., and Captain A. W. Baird, R.E.; *secondly*, the surveying operations of the season and those anticipated during the next five years; *thirdly*, the work executed in the drawing branch and office; *and lastly*, to state the official changes that have taken place during the past eighteen months, and to note the good services of the officers attached to the Department.

4. In the beginning of the year 1878 I informed the Government of India that, after consultation with Captain A. W. Baird, R.E., the Superintendent of Tidal and Levelling Operations in India, regarding the various sea-ports where self-registering tide-gauges should be first established, and in respect to the possibility of finding suitable sites at the

Tour of inspection of the various sea-ports for the purpose of selecting sites for self-registering tide-gauges.

ports selected, where some supervision could be given by the Port Officer or Executive Engineer, not only to ensure that the work, attended to by the native in charge of the instrument, was properly carried out, but also that the accuracy of the time kept by the clock attached was periodically tested by the telegraph from Madras, we considered that much time would be saved and a more satisfactory conclusion arrived at of the capabilities of each port, if Captain Baird and I visited all places in company and decided all questions on the spot.

5. With the above object in view I was permitted in the letter, marginally No. 67 (Surveys), dated the 4th mentioned, from the Department of Revenue, February 1878.

Agriculture and Commerce, to proceed on a tour of inspection, and by meeting Captain Baird at Madras, to go on with him to Tuticorin, Paumben and Galle, as also to Colombo, where we could see Colonel Fyers, R.E., the Surveyor-General of Ceylon, and ascertain how he could help us with a tide-gauge at Galle for the purpose of obtaining accurate tide tables for Ceylon. We were then to continue our coasting tour towards Bombay, visiting *en route* Mootum (Cuddiapatam), which His Grace the Duke of Buckingham suggested to Captain Baird should be one point for a gauge, and subsequently Cochin, Calicut, Bey pore, Cannanore, Mangalore, and Carwar.

6. I was informed by telegraph that Colonel Thomason, R.E., deputed by the Government of India to examine the harbours on the coasts of India, had been authorized to arrange with me for his accompanying Captain Baird and myself in our tour from Madras, and I was directed to meet all his wishes, as also to assist him with my advice.

7. I wished to stay a week at Calingapatam for the purpose of making an examination of the bay and rocks there for Major Thomason, R.E., who was of opinion that a plan of that place would assist his enquiry into the effect which artificial marine works, along the Madras coast, have in arresting the moving sand. As I could not arrive at Calingapatam till the middle of March, when the fresh southerly winds had already commenced, this examination has been unavoidably postponed.

8. From Bombay I was permitted to make my contemplated examination of the Cambay Gulf ports, which the Government of India had previously sanctioned, but which I was prevented from carrying out, during November 1877, in consequence of my inability to obtain the Indian Government Steamer *May Frere*, which was required at that time by His Excellency the Governor of Bombay. During my stay at Bombay, I desired further to test the actual soundings in the upper harbour for the purpose of comparing them with Navigating Lieutenant Palmer's soundings (whose chart of that locality had been sent to me), in order that a full and precise report upon that officer's survey might be furnished to the Government of Bombay.

9. After having thoroughly scrutinized Lieutenant Palmer's chart and Report on Lieutenant Palmer's taken careful soundings in the harbour, I reported survey of Bombay harbour. that it was difficult to understand on what principle he prepared the fair sheet from his original or what method was adopted in the selection of soundings, as several dangerous shoal patches are omitted from the fair sheet, whilst many of his excessive depths are shewn therein close to his minimum depths, and this over muddy portions of the harbour where the bottom is known to be tolerably even and cannot have such inequalities. I stated that it was too much to expect that one man, however quick and talented, in a steam launch, could supervise the steering of the boat, see that the soundings were taken "*up and down*" (*i. e.*, vertically) as well as the noting them in the field book, besides observing, reading off and recording the necessary fixing angles. No one surveyor, without a trained assistant, could have done all this work properly unless the survey of so extensive a harbour as Bombay had occupied him three or four years. At the same time I pointed out that there is much that is valuable in Lieutenant Palmer's report on Bombay harbour, inasmuch as he discussed the question of silting in the upper harbour, his observations and remarks being founded on levels of ancient and recent date; but his chart is of little practical value for scientific comparison, as the contradictory depths therein render it quite untrustworthy for navigating purposes and necessarily preclude any idea of its publication.



10. I proceeded on the above tour of inspection in the British India Steam Navigation Company's Steamer *Rajpootana* on the 8th March 1878, and met Captain Baird at Madras. At False Point, Captain Baird had selected a spot for the tidal observatory on the sandy spit, which is subject to change every year. This position is considered by some authorities hardly suitable, as the observations would be affected in a great measure by the freshets from the Mahanuddy river, and that, perhaps, a better locality might be secured at Balasore. Balasore, however, would not be preferable, because the bar is dry at low-water spring tides. It is specially in the interests of the port of Calcutta that a gauge should be erected somewhere in this neighbourhood, as from these observations, and others which have already been recorded at several points on the Hooghly, correct tide tables for that river may be produced. This is so important in the interests of navigation, that I recommended that the Government of Bengal should be invited to consider the advisability of obtaining from England a complete apparatus of Captain Baird's pattern, for erection at whichever of the above sites may be decided on as being most suitable.

11. Vizagapatam was the next Tidal Station selected by Captain Baird and myself. I informed the Government that the gauge was being got ready in Bombay, and that matters would be expedited if the Government of Madras issued instructions to the Port officer of Vizagapatam to have the house and apparatus placed in position without loss of time. This port was also examined by myself and Colonel Thomason, R.E., who has submitted plans and suggestions, for making a great harbour there, to Sir Andrew Clarke, R.E.

12. At Madras, where extensive works connected with the proposed new harbour are being carried out, it is most important that a complete series of observations, extending over at least two years, should be obtained. The screw-pile pier was the site chosen for the gauge, and explanations were given to the Master Attendant regarding its erection.

13. As the steamer (*Margaret Northcote*) which we expected to find available at Tuticorin had been sent to Bombay for repairs, Captain Baird proceeded by rail to Madura and thence to Paumben by dāk. I did not accompany him, as it was necessary for me to go on to Galle for the purpose of inspecting the light-vessel *Colombo* proposed for the Krishna shoal. I, however, deputed Mr. Morris Chapman (Assistant Superintendent), who was conducting the survey there, to meet Captain Baird and point out a suitable position which had previously been chosen on the mainland opposite Paumben. It should be stated here that the *Colombo* was inspected by me in company with Captain J. T. Lewis, R.N.R., of the British India Steam Navigation Company's Steamer *Rajpootana*, and our report thereon was duly submitted to Government. The vessel is now being used for the purpose for which she was required.

14. The *Margaret Northcote* having returned to Tuticorin by the middle of January 1879, Colonel Thomason and I proceeded *via* Madras to the south of India, and left Tuticorin on the 18th, in that vessel, for the Paumben Pass. We there inspected the present pass and the neighbourhood, and finding that the soundings had not been carried so far eastward as Colonel Thomason required, I took several additional lines of soundings in the *Margaret Northcote*, which proved that the water on the south side of Rameswaram island was much shoaler than was anticipated, and that the survey made by Mr. Chapman required an extension of at least 3 miles to the eastward. I accordingly instructed Mr. Chapman (see Appendix I) to extend the survey in accordance with Colonel Thomason's wishes; this was subsequently done, and a copy of the extension was forwarded to the latter officer.

15. Having approved the position and advised the Master Attendant at Paumben as to the manner in which the house and apparatus should be set up when they arrived, Captain Baird proceeded to Beypore, where we had arranged to meet. We selected at Beypore a most suitable position for the next Tidal Observatory, near the railway terminus, where true Madras time is kept and corrected every day by telegraph.

16. As only a limited number of gauges were in Captain Baird's possession, no site was selected between Beypore and Carwar, though, when the observations have been completed at any of the present stations, it would be desirable to remove one apparatus and establish a Tidal Observatory at Mangalore.

17. Carwar had already been visited by Captain Baird, and a suitable position chosen. The gauge and apparatus there having been set up in the beginning of March, we found it in full working order. It will, doubtless, be advisable eventually to establish an intermediate Tidal Station between Carwar and Bombay. I therefore informed the Government that Ratnagiri would be the most suitable, as it appears probable that it will be in telegraphic communication with Bombay before long, and Captain Baird would be able to connect it, by way of the Ambah Ghât, with his main line of levels through the Dekkan.

18. Before any works could be planned for the improvement of this port, an exhaustive survey of Carwar port was very necessary. I visited the place in company with Colonel Thomason, and he wanted not only a large-scale survey of Beikul cove and Carwar head, but also a chart shewing the actual set of the tidal streams therein and the outside oceanic currents. Such information is not obtainable from the port authorities, who have never noted these phenomena; it is also outside the sphere of Captain Baird's operations, which have to do with the rise and fall and times of tides. I therefore recommended that an elaborate survey of Carwar should be made by No. 1 Party at the commencement of the ensuing season.

19. At Bombay I inspected the gauge erected by Captain Baird on the Apollo Bunder, and found that observations were being steadily recorded.

20. I informed the Government of India that more than two years must elapse before we have an efficient steamer in which a thorough re-survey of the whole Gulf of Cambay could be undertaken, and that by that time some of the gauges now in use would be available for service in the Gulf, and Tidal Observatories might then be established at the mouth of the Tapti river, at or somewhere near the town of Cambay, at Gogo or Bhaunagar, and on the Kattywar coast, either at Shialbet or Diu head. His Highness the Thakoor of Bhaunagar readily agreed to purchase and erect a self-registering gauge near Bhaunagar light-house. The gauge has since been erected and is now in working order.

21. With regard to Gogo, I would mention that Colonel Thomason and I inspected and partly surveyed that place in April 1878, and I believe the Colonel has submitted a preliminary report to Sir Andrew Clarke. I again proceeded there in the *May Frere* in October 1878, and made an examination of the approaches to Gogo and Bhaunagar which will be extremely useful in the preparation of a new chart.

22. It might be at once stated that there is no ship harbour (in the true sense of the word) at Gogo. There is merely a shelf or plateau, with hard clay bottom, over which at lowest spring tides there remains a general depth of only 7 to 10 feet with a few pools of limited extent which have only 10 to 14 feet. Large ships have to anchor five miles off, otherwise nearer to Gogo they would take the ground at low water; and so strong are the ebb tides at springs that two anchors ahead would scarcely hold a paddle steamer like the *May Frere*. Colonel Thomason and I considered that a tidal basin at Gogo creek (for such small vessels as are ever likely to be used for sea communication between Kattywar and Guzerat) is quite a feasible project and not likely to be very expensive. However, I expressed my concurrence, with the opinion of His Excellency Sir Richard Temple, that "the expenditure of money on harbour works at Gogo is of doubtful expediency, as the neighbouring harbour of Bhaunagar is being so much improved by the Native Chief."

23. My further and more lengthy examination of the channel leading from the Gulf of Cambay into Bhaunagar creek proved that the sandbanks, which have increased in extent on its north-east side, only tend to provide more ample and complete shelter to the good anchorage for ships of the largest size which exists off the new light-house at Bhaunagar. I informed the Government that this light is well placed for the purpose of guiding vessels right up to the anchorage from the deep sea; but a lantern, rather larger—say, one of Chance Brothers' 3rd order dioptric, holophotal, with red and green cuts to mark the shoals at the sides of the fair channel—would render the navigation more easy in hazy weather.

24. I was also permitted to confer with Captain Baird at his office in Poona—where all the records of the Tidal observations are collected—on the several important points connected with the subject which it was desirable to settle,

especially with regard to the *form* in which the tide tables, required for nautical use, should be published when compiled, and the selection of the fixed datum levels to which our local soundings should be reduced. Amongst the appendices of this Report will be found a reprint of an order issued by myself to the Officers of the Department regarding Tidal observations in India, as also my memorandum on Indian tides; these will be found in Appendices B and C.

25. I am now occupied, amongst other engagements, in preparing a corrected edition of the West Coast of Hindostan Pilot, as also the first edition of an East Coast of Hindostan and Bay of Bengal Pilot—the necessity for which has long been felt by navigators in these seas, as so many ports have of late years opened up, of which no mention whatever is made in any Sailing Directory extant.

26. Later on I was permitted to carry out a more extensive inspection of the several harbours of India in company with Colonel Thomason, R.E. During this inspection much valuable hydrographic information was gathered, which will be incorporated in the new edition of the sailing directions above referred to. The season was too far advanced when Colonel Thomason accompanied me in the Indian Government Steamer *May Frere* to the Gulf of Cambay; we wished to inspect the mouths of the Tapti and the Nerbudda, but unfortunately could not, as the southerly winds caused a heavy swell, whilst the haze was so dense that we could not identify shore objects or see the beacon lights by night at less than half their proper visibility.

27. At Verawal, of which there was no chart, I determined the positions of the new light-house and new piers, and by sounding in the roadstead I discovered some dangerous patches of rock outside the port. After my examination of this place we were enabled to publish a useful chart.

28. No chart of the port of Seraia having been published hitherto, I examined the place and made several additions and corrections to the original survey. Some valuable information affecting navigation was obtained by me, and a chart shewing the result of the work done here is being prepared for publication.

29. Whilst at Cutch Mándvi I took observations to test the triangulation of the larger scale originals from which our new chart of that place was compiled. In forwarding a copy of this chart to the Hydrographer of the British Admiralty, I pointed out that the present Admiralty chart of Gulf of Cutch was a compilation from surveys by Grieve, Constable, and myself. I fully remembered Mr. John Walker writing to me some 25 years ago that Grieve's latitude of Assar pagoda differed about half a mile from mine, and remarking to me that the Great Trigonometrical Survey would soon be going to Cutch, and then we should know which was right. Soon after that the Gulf of Cutch chart was published, but I never had an opportunity of revisiting Mándvi, and of testing this, until the other day. Some Commanders of the British India Steam Navigation Company had recently told me that the chart was quite wrong about Mándvi; I therefore went there, and took with me my own original drawing of the approaches to Mándvi, done when I was Selby's assistant in 1847, but never published by the East India Company, which drawing was in the Hydrographic office of the Admiralty from the time the documents were sent there until they were made over to me with the majority of the Indian originals in 1874. I tested this sheet by angles and found my bearing of Assar pagoda from Cutch Mándvi light-house to be perfectly correct. The true line of bearing was afterwards marked on a chart which was forwarded to the Hydrographer. I think it may be gathered from the above that Walker accepted Grieve's latitude of Assar pagoda and my latitude of Mándvi. This error caused the chart of the Gulf of Cutch to be hitherto looked upon with distrust by navigators. The Hydrographer has since informed me that the Admiralty chart has been corrected.

30. I was also authorized to visit the ports of Burma, as also Port Blair, in company with Captain A. W. Baird, R.E., to select sites for two or three self-registering tide-gauges and to gather information of utility to navigation. We examined both Diamond and Hinghie islands at the mouth of the Bassein river

and obtained the opinions of the Bassein pilots stationed on Diamond Island respecting a site for a gauge at one of those places, and at the same time I discussed with them all the dangers in the navigation of those waters. A full account of the work accomplished during the above-mentioned tour will be found in the reports published in Appendices H and I which were submitted to the Government of India.

31. In connection with my visit to the Cambay Gulf, I should state that a petition, signed by upwards of seventy native ship-owners and ship-masters, was submitted to my office, and I was informed therein that, in consequence of the existing lights being insufficient and of the imperfect state of the chart, a large number of vessels are either wrecked or damaged every year by the sand-banks existing in the Gulf. The petitioners solicited that a thorough examination of the Gulf might speedily be made in the interests of navigation.

*Surveying Operations of the season, and proposals for the next five years.*

32. The surveying operations of this season were carried on, as in the pre-

*No. 1 (Bombay) Party.*

Navigating Lieutenant F. W. Jarrad, R.N., Deputy Superintendent in charge.

Navigating Lieutenant E. W. Petley, R.N., Assistant Superintendent.

Navigating Lieutenant T. C. Pascoe, R.N., Assistant Superintendent.

Mr. P. J. Falle, Assistant Superintendent.

Surgeon J. Armstrong (Bengal establishment), Medical Officer and Naturalist.

*No. 2 (Madras) Party.*

Mr. Morris Chapman, I.N., Assistant Superintendent in charge.

Lieutenant W. H. Coombs, R.N., Assistant Superintendent.

Mr. W. H. W. Searle, Officiating Assistant Superintendent.

vious season, entirely by two boat parties, each consisting of the officers mentioned in the margin, as also one engineer for the steam-cutter, two tide-watchers, two leadsmen, two secunies, three stokers, five lascars, one messenger,

and one clerk. Each party was provided with a steam-cutter, a pulling (whale) boat, tents, and the necessary surveying gear.

33. I informed the Government of India that there is little prospect of the new surveying steamer being ready for work before the rainy season of 1880-81, and that, therefore, in the absence of a properly equipped vessel, surveying work must be carried on as at present by boat parties. The survey of a large port like Akyab could not be undertaken with only small steam-cutters, and Navigating Lieutenant Jarrad reported that even the Indian Government Steamer *May Frere* was unsuitable for the coast work which he executed in that vessel last season. It was therefore impossible, with any satisfaction, to send a party to survey the Gulf of Cambay, which most requires attention on the west side of India, or to Akyab in British Burma.

34. The following are the instructions issued to the officers in charge of the above-mentioned survey parties in regard to the work they were required to execute. Full particulars of the work accomplished have been furnished in Section III:

35. Lieutenant Jarrad was ordered to make a thorough survey of Jyghur port, including the prominent headland and a part of the river. This was another port of shelter during the south-west monsoon, and Sir Richard Temple expressed a wish that a thorough survey should be made as soon as possible. Jyghur was taken up after Ratnagiri in consequence of its proximity to the latter port.

36. The next place which Lieutenant Jarrad's party was to undertake was the entrance of the Dabhol or Anjenwil river, which the Collector of Ratnagiri, Mr. Arthur Crawford, was very anxious to have thoroughly surveyed, as the passenger traffic by coasting steamers is rapidly increasing, and it was necessary to know where to place lights and buoys.

37. The recent erection of the Chaul Kadu beacon and my visit to the locality shewed me the danger of allowing the approaches to Bombay harbour to remain inaccurately delineated on the Admiralty chart. The Chaul Kadu rock did not even appear on the chart. Lieutenant Jarrad was, therefore, instructed to make a scientific examination of that reef and its neighbourhood; in fact, all below Kenery island to Chaul with a view to our being able to compile a more

comprehensive chart of Bombay and its approaches. The necessity for an improved chart was pointed out in a report furnished to the Government of India during August 1877; but, since my discovery of the incorrectness of the existing chart in regard to the Chaul Kadu reef, the urgency of such a work became more apparent.

38. The establishment of a self-registering tide-gauge in Bombay harbour by the Superintendent of Tidal and Levelling Operations rendered this season a most favourable opportunity for setting at rest the disputed question regarding the datum level to which the soundings in and off Bombay have been reduced, and for taking fresh and accurate soundings to check those given by Lieutenants Whish and Palmer on their respective charts. I informed the Government of India that Captain Baird's tide-gauge was at full work in Bombay harbour, and would be a great help to the Surveyors, as also that its registrations would be continued for more than a year. I moreover stated that, by synchronous observations taken at or near Alibag by Lieutenant Jarrad, we should learn also the difference in the range of tide, both outside and inside the harbour of Bombay.

39. In connection with preparing a more comprehensive chart of Bombay harbour and its approaches, I informed the Government that we could utilize the good portions of Lieutenant Palmer's recent survey, whilst those portions of it reported by me as being improperly sounded should again have the depths systematically measured and reduced to a correct datum by Lieutenant Jarrad and his party.

40. In regard to the operations entrusted to Mr. Morris Chapman, I had previously pointed out to the Government of India and obtained premature sanction to those surveys which could be most conveniently undertaken. Mr. Chapman's work embraced firstly Tuticorin (where his boats and surveying gear were at the commencement of the season), then Cochin, and subsequently Beypore.

41. The survey of Tuticorin was to be on the same scale as Franklin's original survey of the harbour and roadstead, i. e., 4 inches = one nautic mile, and the necessity of making an exhaustive search for rocky patches in the western side of the anchorage, was fully pointed out to Mr. Chapman. He was to carefully sound the southern passage into the harbour (which is entered to the south-west of Moorum Shulli Tivo and goes up past Devil's Point), in order to find, if possible, a clear channel, as also to indicate the sites for leading marks inward.

42. The Government of India have been informed from time to time what ports, in my opinion, urgently require examination. I should, however, state that many applications have been made to the Marine Survey Department for the execution of surveys of other ports which, although they require attention, cannot be taken up, as the means at our disposal at present are so limited. But it must be stated that we have endeavoured to comply with demands made on us whenever it has been found practicable to do so without affecting the interests of the public service.

43. During the survey of the Dabhol river a pressing request was made to me by Mr. J. A. Shepherd of Bombay, the owner of a large number of coasting steamers, for a survey of the Bankote river by Lieutenant Jarrad's party before they proceeded to Chaul. Mr. Shepherd offered to convey the party in his steamers from Dabhol to Bankote, and afterwards to Bankote free of charge, and he wrote as follows:

"I venture, as the only European ship-owner who has steamers frequenting Bankote twice daily, to address you an urgent appeal that you kindly direct the survey of the Bankote Bar being immediately taken in hand on completion of the Anjenwil survey. Bankote has the largest traffic of any of the Konkan rivers, and being at the same time the most dangerous, I trust you will direct it being surveyed this season, as it is the only place on this coast the commanders of my steamers are afraid of; and I believe that, with a proper survey, leading marks may easily be so arranged that it may be made, if not quite safe, certainly much more than it is now." I also received a telegram from the Private Secretary of His Excellency Sir Richard Temple, in which he stated that the "Governor would be grateful if Bankote survey could be under-

taken immediately after Dabhol." Meanwhile the survey party had proceeded to Chaul, and having informed Sir Richard Temple of this by telegraph, I reported by letter that the survey of Bankote was not included in the programme of the Marine Survey operations for the season, and that as the Government of India had approved the programme, it could not be modified in any way without the previous sanction of Government. I moreover stated that the

\* Bankote has lately been thoroughly surveyed by No. 1 Survey Party, and will be noticed in next year's Report.

season was too far advanced to enable the work to be attempted, but that it would be attended to when the operations of the ensuing season were under consideration.\*

44. The Chief Commissioner of British Burma requested my opinion on a suggestion of the Commissioner of Arakan, that the

Surveys of Naaf and Sandoway rivers.

entrance to the Naaf river should be buoyed off for the purpose of facilitating and developing the trade carried on at Naaf. I was asked to state the probable cost, as also when it would be convenient for an officer of this Department to be deputed to do the work. I informed the Chief Commissioner that the river could not possibly be buoyed off, nor the expense of the operations be estimated until the place is surveyed, and I mentioned that, with the permission of the Government of India, I should examine the entrances of both the Naaf† and

† Both these places have since been examined by me; reports thereon will appear in next year's annual Report.

Sandoway† rivers, during January or February 1880, provided the Indian Government Steamer *Hugh Rose* or *Enterprise* could be lent for the purpose. My attention was invited to the great inconvenience caused to the public service and danger to boats by steamers lying some distance out from the mouth of the Sandoway river, and the necessity of an examination of the place was urged by the Commissioner of Arakan.

45. In the early part of August 1878, I was informed by the Government of Bengal that the Commissioner of Orissa had expressed a wish for a survey of the channel from

Survey of Dhumra river.

Chandbally to the sea to be undertaken by the Port officer of Chandbally (Mr. Webster), and I was requested to furnish the Lieutenant-Governor with my advice as to the nature of the survey to be undertaken by the Port Officer and the appliances actually required for the purpose. Having visited Chandbally and ascertained what was necessary, I made the following suggestions:—

- (a) That the mouth of the Dhumra river, up to the village of Dhumra, should be surveyed in detail by the Port Officer, under the instructions of the Marine Survey Department, whence instruments for the work would be lent.
- (b) That for the purposes of the survey, the Port Officer should be provided with either a steam launch or an accommodation boat.
- (c) That from Dhumra to Chandbally buoys were already laid, and that only beacons were required to shew certain points which are submerged in the rains.
- (d) That the Palmyras Reef buoy required to be placed in position; but that this was to be done by the *Clyde*, river surveying vessel, which was to be sent to Chandbally in February or March 1879 for that purpose, to work in communication with the Port Officer.

46. The Lieutenant-Governor having accepted all my suggestions and sanctioned the survey of the Dhumra river, as proposed by me, the necessary instruments and full instructions for the survey were forwarded to the Port Officer; but unfortunately the work was never executed, as Mr. Webster fell sick and was afterwards transferred to Calcutta as Assistant River Surveyor.

47. During the year 1878, the Government of Travancore informed me that

Survey of Quilon Roadstead.

† The chart of Quilon has lately been corrected by me, and some valuable additions have been made thereto.

a survey of Quilon Roadstead† was much required in the interests of the Scottish India Coffee Company, who have large vested interests in South Travancore, and I was asked to express my views on the matter, as also to state the probable cost of such a survey. I informed the Government that the means at the disposal of this Department would not permit of a survey of Quilon being undertaken for some time, and moreover that, from my knowledge

of the place, I was confident that no harbour could be constructed there except at very considerable expense which would not be warranted by the trade of the port.

48. The Indian Government Steamer *May Frere* having grounded near Hog Island, the Government of Bombay requested my attention to a suggestion of the Superintendent of Marine, Bombay, that a survey of the approaches and vicinity of the hydraulic lift should be made by the officers of this Department. From personal inspection I ascertained that an immediate examination was not necessary and communicated this view to the Government, intimating at the same time that the matter should be fully considered when the general survey of the Bombay foreshore was resumed.

*Surveying Operations anticipated during the next five years.*

49. In paragraphs 1 to 4 and 14 of the Right Honourable the Secretary of State's despatch No. 8 (Geographical), dated the 24th January 1878, received with the letter marginally noted, His Lordship, after reviewing the first Annual Report of the Marine Survey Department, asked for a programme of the probable work which this Department would be able to carry out during the ensuing five years.

50. In submitting this programme, I informed the Government of India that the work would, of course, be dependent on the means at our disposal. I also stated that at present we have only two small steam-cutters which do tolerably well for surveying small river mouths and minor harbours; but where tidal currents are strong and the water deep, these boats are quite inadequate.

51. I wish to state here what my proposals were in the programme furnished for the information of the Secretary of State, and what portion of the work has been carried out up to the present time.

52. In the absence of the surveying steamer which is building in the Bombay Dockyard, I stated that till the vessel is ready, or for the first eighteen months of the five years, the following surveys may be executed by the two boat parties under the two senior officers employed.

53. At the end of the south-west monsoon, Lieutenant Jarrad's party was to survey the bay and river of Jyghur. This survey has been executed as His Excellency Sir Richard Temple desired that it should be effected as soon as possible.

54. Anjenwil or Dabhol river mouth was the next survey recommended, and subsequently an examination of the Chaul Kadu and other reefs off Alibag below Kenery island. The survey of Chaul was desired, in order that, with some sectional soundings in the harbour, we might be enabled to produce a more useful chart of the approaches to Bombay, exhibiting the coast line from Mahim to Chaul on one large sheet. The above surveys have also been completed.

55. The examination of the banks and shoals (lately sprung up) off Bhaunagar and Gogo was to be taken up next by Lieutenant Jarrad's party; but this was contingent upon our being able to obtain a suitable steamer to enable us to do the work. I informed the Government of India that Bhaunagar is being connected by rail with Wudwan, as also that the sea-traffic to these ports would probably increase, whilst the existing charts are extremely dangerous.

56. The party under Mr. Chapman was to be employed first in the examination of Tuticorin and Cochin, afterwards at Beypore and Mangalore. Of these ports only the survey of Tuticorin has been accomplished; the others have been abandoned for the present in consequence of Mr. Chapman's death, and as we have no officers available to carry on the work.

57. When the new steamer is ready for sea she will require all the Surveyors now entertained in the Department. There are several important surveys of coast lines and harbours that are much needed at present. The only question



to be decided is the sequence in which the work should be taken up. The following sketch was submitted to the Government of India as approximate: Orissa coast from Dhumra river to Chilka lake; thence the Ganjam coast to Bimlipatam. The duration of this survey may be limited to one year, if the Great Trigonometrical Survey is permitted to triangulate the Orissa coast. If this latter operation must be conducted by the Marine Surveyors from the steamer, the complete examination of such a coast may occupy two years. Among the surveys most required, that of the port of Akyab and its approaches, including the Oyster-reef light, deserves particular mention. This work was twice taken up by the officers of the Marine Survey Department, and was unfortunately abandoned before it was fairly commenced, in consequence of the outbreak of cholera at Akyab. On the first occasion one of the Surveyors died from the disease. The entrance of Bassein river, including Diamond island and the Phœton shoal with Alguada reef, as also the coast adjacent, requires thorough examination. Afterwards the mouths of the Irrawadi river, the Baragua flat, the Krishna shoal and coast line into the Gulf of Martaban, as far round as Amherst. The above represents more than two years' work, and during that period some sectional lines of soundings combined with dredging would be run across the Bay of Bengal as occasion offers.

58. The Gulf of Cambay is the next important survey, so great have been the changes in its shore line and banks during the last forty years. Both the Kattywar and Guzerat shores of the Gulf have been most accurately surveyed and delineated by the Great Trigonometrical parties under the Surveyor-General, and thus the re-examination of that Gulf is much simplified. The hydrographic work would fully occupy the time of our steamer for twelve months.

59. In the above scheme I sketched out, for the information of the Secretary of State, the utmost amount of thorough work that can approximately be carried out by one steamer during the next five years; but the programme will, no doubt, be considerably modified as the new surveying steamer will not be ready so soon as I had at first anticipated, and the urgent necessity of having other ports examined, either for engineering or political purposes, would necessarily interfere with the above proposals. It remains for me to mention what I proposed to do myself during the same period with the permission of the Government of India.

60. I expect to be able to arrange several desultory examinations of ports where banks and shoals periodically change or grow, such as Dhumra river mouth, False Point, Cocanada, and Chittagong. Also preliminary examinations of hitherto unsurveyed small ports, such as the Naaf river with Sandoway and Gwa on the Burma coast; and Bhaunagar, Gogah, Shial-bet, and Diu head on the Kattywar coast. I also desire to accomplish an inspection tour of two or three months' duration through the Mergui Archipelago which was once sanctioned, but unavoidably postponed. Cheduba strait, the coast in the vicinity of Tavoy, as also the Andaman Islands, are localities which need examination.

61. Much valuable information has been gathered on the few desultory tours which I have been able to make, and it is my earnest desire to effect at least one inspection every fine season. I have been informed that His Excellency the Governor General in Council has authorised me generally to arrange for my tours as I think most expedient in the interests of the public service, provided my budget allotments are not exceeded.

62. The Natural History investigations of the season have necessarily been confined to observations of the invertebrates inhabiting the shore line of the Northern Konkan in the vicinities of Dabhol, Rewadanda, and Chaul, and of the ornithological fauna found in the adjoining districts.

The following is an extract from Dr. Armstrong's Report of Proceedings:—

"Amongst the invertebrate group two hitherto undescribed species of hydroids (*Lafoëa plumoso* and *Desmoscyphus humilis*) have been obtained, and their descriptions recorded in the Asiatic Society's Journal for July.



"A large number of ornithological specimens were killed, but of these only some 70 or 80 specimens were preserved. It was impossible to preserve a large number in consequence of the incompetency of the taxidermist who was attached to the party, and whom, after a couple of months' trial, it was found necessary to discharge. All the specimens obtained, as well as those of the previous season, have been forwarded to the Superintendent of Marine Surveys, prior to learning the wishes of the Government with regard to their ultimate disposal.

"Advantage was taken of whatever time could be spared from field work to examine, as far as possible, the various specimens of zoophytes that had been collected during previous seasons, with the result of discovering eight species of hydroids, all of which were quite new to science. The description of these with structural drawings of each formed the subject of a paper on 'some new species of Hydroid Zoophytes from the Indian Coasts and Seas,' which has been published in the Bengal Asiatic Society's Journal."

The paper referred to by Dr. Armstrong is published in Appendix F of this Report, together with the illustrations mentioned therein which the Council of the Asiatic Society of Bengal kindly permitted us to reprint.

63. Altogether Dr. Armstrong collected about 900 ornithological specimens during the seasons 1877-79 in the vicinities of Ratnagiri and Viziadurg, all of which were carefully stuffed and sent to Calcutta, as he was unable, without reference to a larger museum than he had access to at Bombay, to identify all the specimens. The Government of India having decided that they should be made over as Government property to the Indian Museum, they were accordingly forwarded to the Superintendent of the Museum.

64. In connection with the physical exploration of Indian waters when the new steamer is ready, the Council of the Asiatic Society of Bengal made some valuable suggestions as to the area to be examined, the method to be used in its examination, the due preservation of the specimens obtained, the record of observations, the arrangements necessary for facilitating the examination and determination of specimens, and the ultimate destination of the collections made. The Asiatic Society moreover recommended that the services of Messrs. Murray and Piercy, who both accompanied the *Challenger* expedition, should be secured in view to taking up the work of research from the point reached at the close of the voyage of that vessel. The Government of India deemed it advisable to postpone the consideration of the above suggestions, but they will doubtless receive full attention when the *Investigator* is ready.

65. The work in connection with the construction of the new steamer is being satisfactorily carried on in the Bombay Dockyard, but the vessel cannot possibly be ready till the surveying season of 1881-82. I applied for permission to name the steamer, the *Research*, that being an appropriate name for a vessel engaged on surveying service, and moreover one intimately connected with the early surveys of the Indian Navy; the surveying ship *Research* was employed under Captain Daniel Ross during the Burmese War, 1824-26, and was afterwards sent in search of the French navigator *La Perouse* to the New Hebrides Islands, whence she returned in 1828 with certain relics of the great navigator. But as a vessel called the *Research* exists in the British Navy, the Government of India, in order to avoid possible confusion, were pleased to direct that our steamer shall be called the *Investigator*. The Government also sanctioned the performance of the ceremony of driving the silver nail, particulars of which are given in the following extract taken from the local paper of the 14th December 1878:—

"At 5 o'clock on the afternoon of Wednesday last, the 4th December, the ceremony of driving the silver nail in the stem of the new paddle steam-vessel building in the Bombay Government Dockyard, for the coast survey of India, was performed in the presence of a number of ladies and gentlemen, under the shed where the vessel is building, which was tastefully decorated with flags, and where a platform had been erected and seats provided for the spectators.

"This ceremony is, we believe, peculiar to Bombay and of early Parsee origin, the practice being akin to that of depositing coins, &c., under foundation stones or memorials. The nail is of silver, about 7 inches in length and  $\frac{1}{4}$  inch diameter near the head; the four sides bore the following inscriptions: (1). Indian Government surveying steamer *Investigator*. Bombay Dockyard, December 1878. (2). The Right Hon'ble Lord Lytton, G.C.S.I., Viceroy and

Governor General. (3). The Hon'ble Sir Richard Temple, G.C.S.I., Governor of Bombay. (4). Captain G. O'B. Carew, I. N., Officiating Superintendent of Marine; and Jamssetjee Dhunjeebhoy Wadia, Master Builder.

"The ceremony was commenced by Miss Carew, daughter of the Officiating Superintendent of Marine, who gave the nail three blows with a silver mallet, other ladies doing the same in succession until the nail had been driven into the solid teak stem. By means of punching, the nail was countersunk about three inches, and a wooden treenail driven in above."

66. Complete plans of the new steamer with a specification of the engines required for the vessel were prepared and furnished to the Government of India for submission to the Secretary of State, and I was informed that His Lordship has been asked to expedite the transmission of the machinery to the Bombay Dockyard.

*Work executed at Head-quarters.*

67. During my inspection tours, which have necessarily caused long absences from Calcutta, Mr. R. C. Carrington—who has been holding charge of the office of Deputy Superintendent, 2nd Grade, since the departure of Staff Commander Ellis, R.N.—has, with the approval of the Government of India, remained in charge of the office at head-quarters.

The Compiling and Drawing Branch has again turned out valuable work, full particulars of which will be found in Section II. The staff of assistants sanctioned for this branch is mentioned in the margin. There is abundance of work to engage a larger number of draftsmen than is employed at present. Having published seven general charts of the coasts of British India, we now wish to produce large-scale sheets of many localities where trade has greatly increased during the last few years, and the charts of which, in many cases, are dangerously erroneous. On my periodical tours round the coast I have ascertained from the various local marine and mercantile authorities many of their urgent requirements as regards charts, and the Drawing Branch has always done its best to meet these wants.

68. When I was in Madras during March 1878, I discovered that a very large number of old and obsolete charts had been stored there for many years, and it was important that they should be thoroughly scrutinised by a competent person. I at first contemplated having these sheets examined by Mr. Carrington at Madras; but, after discussion, I found this unnecessary, and eventually they were forwarded at my request to this Department. Mr. Carrington examined 4,852 charts, out of which 433 useful copies were kept for reference, and 4,419 were cancelled and destroyed, being old editions of Admiralty or East India Company sheets; many of the charts destroyed were uncorrected since first issued, some twenty to seventy years ago. The whole stock was thoroughly examined by Mr. Carrington, and his remarks explaining why the various sheets were cancelled will be found in Appendix D.

69. The staff of clerks at head-quarters throughout the year was as mentioned in the margin, and they have been fully employed and have done a large amount of work. The number of official letters and office memoranda, issued during the period embraced in this report, aggregated 3,379, and upwards of 450 demi-official letters were sent out. In addition to these, several lengthy reports relative to subjects referred to me for opinion were prepared, and furnished to the Government of India. The Comptroller-General and the Accountant-General of Bengal were supplied with a large number of estimates and statements required by them. The monthly cash accounts received from the survey parties were regularly examined, and submitted to the Comptroller-General. The work of my office has increased considerably, and the clerks were frequently hard pressed; but I have much pleasure in reporting that activity always prevailed in the office, and that the work has been quickly and carefully done.

70. A number of nautical questions were forwarded to me by the Governments of India, Madras, Bombay, and Bengal, and were duly reported on. Among the most important of these were:—

Questions affecting navigation. System of buoyage for Indian harbours.

On the question of substituting screw-pile light-houses for light-ships at the Sandheads.

Limits of the ports of Cocanada, Masulipatam, and Calicut.

On the condition of the light-vessel *Colombo*, and her fitness to replace the *Star* at the Krishna shoal.

On the extension of the *foul* weather season on the west coast of India, south of Carwar, from 1st June to 30th September.

On a proposal made by the Government of Bombay for extending the *fair* weather season up to 15th May on the Sind, Bombay, and Malabar coasts.

On the merits of certain sailing directions for the River Megna, prepared by Mr. Laycock, the Hooghly River Surveyor, and the advisability of publishing them for the benefit of the nautical public.

On the number of chronometers which it is absolutely necessary should be on board a coasting-vessel.

On the advisability of adopting certain proposals of the Officiating Port Officer of Calcutta, advocating an economical method of carrying out a change in the system of buoyage in the Hooghly river.

On the lighting of the approaches to the Hooghly river.

On the advisability of adopting a different pattern of buoy, instead of the Bell buoy, for guarding the tail of middle ground in Hooghly river.

On the lighting and buoyage of the approaches to the Moulmein river.

A change of form of the entrance of the Madras harbour works proposed by Mr. Parkes, Engineer-in-Chief of the works. •

On surveys and improvements of the harbours in the Bombay Presidency.

A steam ferry across the Gulf of Cambay.

On the suitability of the site at Jagaiswar, at the mouth of the Nerbudda, for constructing a steam pier.

Regarding two scales to be incorporated in the agreement under the Merchant Shipping Act IV of 1875 between the master of every ship and every seaman whom he carries to sea, exhibiting the minimum daily scale of provisions for native seamen engaged in home and foreign-going ships, respectively, sailing from any port in India.

On a better system of lighting the entrance of Rangoon river.

Regarding the removal of the Manora Head light-house in connection with the scheme for the defence of Kurrachee harbour.

71. In the beginning of 1879 I was requested to furnish the Government of India with my opinion on certain proposals of the Marine Department involving an estimated outlay of nearly 1½ lakhs of rupees annually in the maintenance of a special steamer for inspection and relief of all Indian light-houses. I was likewise asked for my opinion on the general administration of Indian lights, as also whether I considered any material improvement necessary; and if so, in what direction. My general report on the above questions will be found in Appendix A.

72. During the period embraced in this Report, five Hydrographic Notices and forty-seven Notices to Mariners, relating to new lights, buoys, and newly-discovered dangers, have been published. The number of copies of Hydrographic Notices, printed during the year, amounted to 1,500, and of Notices to Mariners to 18,800; and out of these, 1,150 copies of the former notices and 15,275 of the latter were forwarded to ninety-six Indian Maritime authorities and foreign Governments. From the nautical notices that are sent to us every week it is observed that the publications of the Marine Survey Department are regularly reproduced by all the principal Hydrographic Departments throughout the world.

73. The following table shews the Notices to Mariners and Hydrographic Notices issued between the 1st April 1878 and 30th September 1879 inclusive:—

Number of Notice.	Number of copies printed.	Locality to which Notices refer.	Subject.
<i>Notices to Mariners.</i>			
1878. 12	400	India, Bay of Bengal, entrance to river Hooghly.	Announcing that, on and after 1st October 1878, signal guns will be fired during fogs, at intervals of half an hour, from the Lower Gaspar light-vessel, at the hour and half hour, and from the Upper Gaspar light-vessel at the first and third quarters of the hour; also mentions the distinguishing marks for the Pilot's Ridge and the Mutlah light-vessels.
13	400	Ceylon, South-East Coast	Announcing the exhibition of a light from the light-house recently erected on the Little Basses rocks.
14	400	Hindustan, West Coast, Bombay Harbour.	Regarding the erection of a beacon on the Choul Kádu rock, off Alibagh.
15	400	Persian Gulf . . .	Respecting the shoal near Tumb island (Jazírat Tanb).
16	400	Ceylon, East Coast . . .	Exhibition of a light on the flag staff near the mouth of Butticaloa lake from the 15th February to the 31st October.
17	400	India, Bay of Bengal . . .	Announcing that, from the 1st July 1878, a supplementary maroon will be exhibited from the <i>Foam</i> Pilot brig during the time she does the duty of the Upper Gaspar light-vessel.
18	400	Bay of Bengal, Coromandel Coast.	Exhibition of two red lights at the outer end of the north groin of the Madras Harbour Works.
19	400	Persian Gulf . . .	Announcing the discovery of a shoal patch in the Persian Gulf, N. N. E. of Bahrain.
20	400	Strait of Malacca, Salangore, Malay Coast.	Regarding the alteration of the colour of the light exhibited on Middle point, Klang Strait.
21	400	Persian Gulf . . .	Description of the reported shoal patch in the Persian Gulf, N. N. E. of Bahrain.
22	400	Bay of Bengal, Coromandel Coast.	Deposit of stone eastward of the Madras Harbour Works.
23	400	Bay of Bengal, Coast of Burma	Intimates the discovery of a shoal patch north-west of Beacon island, Cheduba.
24	400	Ditto ditto . . .	Regarding the exhibition of blue lights and maroons at the Krishna shoal light-vessel on and after the 1st November 1878.
25	400	Bay of Bengal, Coromandel Coast.	Respecting the deposit of stone, eastward of the Madras Harbour Work.
26	400	Bay of Bengal, British Burma, Bassein river.	Prohibiting vessels from anchoring near the submarine telegraph cable between Diamond island and the mainland.
27	400	Bay of Bengal, Godavery District, Cocanada.	Announcing the intended exhibition of a revolving light at Vakalapudi.
1879. 1	400	India, Bay of Bengal, approach to river Hooghly.	States that permanent moorings have been laid for the Eastern Channel light-vessel, and the position which the vessel will occupy all the year round.
2	400	Bay of Bengal, Coast of Tennasserim.	Regarding the discovery of a dangerous patch of rock and sand in Mergui Archipelago.
3	400	Bay of Bengal, Godavery District, Cocanada.	Announcing the exhibition of a revolving light at Vakalapudi.
4	400	Bay of Bengal, coast of Orissa.	Notifying the intended alteration of the light at False Point.

Number of Notices.	Number of copies printed.	Locality to which Notices refer.	Subject.
1879			
5	400	India, West Coast, Malabar Coast.	Stating that the entrances to Honore (Honawa), North Canara, and to the Mangalore river, South Canara, have shifted.
6	400	India, West Coast, Gulf of Cutch.	Regarding the fixed light exhibited on Roji island (Nowa-Nugga), south shore of the Gulf of Cutch.
7	400	India, West Coast, Gulf of Cutch.	Regarding the exhibition of a light at the entrance to Toona Creek, north shore of the Gulf of Cutch.
8	400	India, West Coast, Kattywar	Relative to the light exhibited at Goapnath Point, at the entrance to the Gulf of Cambay.
9	400	.....	Regarding the colour of vessels marking wrecks and the signals to be shown by them.
10	400	India, Bay of Bengal, Coast of Orissa.	Respecting the alteration in the position and improvement of the light exhibited at Pooree.
11	400	Eastern Archipelago, Celebes island, North coast.	Notifying the existence of two coral shoals lying nearly in the fairway of Strait of Banka, north coast of Celebes island.
12	400	Africa, East coast, Delagoa Bay.	Stating that the light-vessel placed on the western side of Cockburn shoal is removed during bad weather.
13	400	Australia, East coast . . .	Regarding (1) the alteration in the position of the beacons and leading lights, from the northern to the southern side of Burnett river entrance, (2) exhibition of a light on flat top islet, off the entrance of Pioneer river, (3) exhibition of a light on the westernmost low islet, Trinity Bay, and (4) exhibition of two leading lights at Cook town, Endeavour river entrance.
14	400	Bay of Bengal, British Burma.	Respecting the existence of five separate shoal ridges between Alguada reef and Diamond island, Bassein river entrance; also states the correct position of Alguada reef light-house.
15	400	New Zealand, South-West extremity of Middle island.	Intimates the exhibition of a flashing white light on Puysegur Point.
16	400	Bay of Bengal, Andaman Islands.	Announces the existence of dangerous rocks, N. N. W. and S.-E. of the southernmost of the Brothers islands which lie to the north-east of the Little Andaman Island.
17	400	Australia, South Coast . . .	Regarding (1) the prohibited anchorage near the telegraph cable laid between Kingscote harbour, Kangaroo island and Yankalilla bay on the mainland, Gulf of St. Vincent, (2) the buoys marking the Battery practice range at Williamstown, Port Phillip, (3) the exhibition of a fixed and flashing light on north reef, Capricorn channel.
18	400	India, Bay of Bengal, River Hooghly.	States the longitude of the Time Ball, Calcutta, and of Saugor light-house.
19	400	Eastern Archipelago, Java . .	Respecting (1) the discontinuance of the additional light at fourth point, Sunda Strait, (2) the existence of a shoal in the approach to Batavia road, north coast, and (3) the exhibition of a fixed light on Meinders reef, Madura Strait.

Number of Notice.	Number of copies printed.	Locality to which Notices refer.	Subject.
1879 20	400	Africa, South Coast . . .	Regarding (1) the existence of dangerous shoal found westward of Durnford point, (2) the mouth of Tugela river, and (3) the mouth of Umbloti river.
21	400	India, West Coast . . .	Stating that the buoys marking the rocks off the entrance to Carwar harbour (Sedashigar) have been washed away.
22	400	Indian Ocean, Reunion island.	Regarding (1) the alterations in the lights at St. Paul and St. Denis, Reunion or Bourbon island, and (2) the exhibition of a harbour light at St. Pierre.
23	400	India, West Coast . . .	Respecting the buoys off Carwar harbour, (Sedashigar).
24	400	Africa, East Coast . . .	Regarding the buoys and beacons in Zanzibar harbour.
25	400	Bay of Bengal, Coast of Orissa	Notifying that during the improvements to the lantern and lighting apparatus at False Point light-house, the light will be discontinued, and a blue light immediately followed by a rocket will be burnt from the upper part of the light-house for three months commencing from the 1st November 1879.
26	400	India, Malabar Coast, Port of Alleppey, Travancore.	Regarding the red buoy marking the smooth water anchorage off Porcaud.
27	400	Bay of Bengal, Coromandel Coast, Madras.	Respecting the change in the anchorage limits of the port in consequence of the extension of the harbour works into deep water.
28	400	Red Sea, Hedjaz, Arabian Coast.	Announcing the discontinuance of the light at El-Weg (Sherm-Wej-h).
29	400	Bay of Bengal, Orissa Coast .	Regarding the interval of the blue light and rocket signals to be exhibited from the False Point light-house, from the 1st November 1879.
30	400	Hindotan, West Coast . . .	Stating that the buoys moored to mark the entrance to Cochin harbour have been replaced, and that the light on Narakel will be extinguished.
31	400	Bay of Bengal, Coast of Burma.	Regarding the range of visibility of the light exhibited from the Krishna shoal light vessel.
			<i>Hydrographic Notices.</i>
10	300	India, South Coast, Gulf of Manaar.	Contains information relating to Pamban (Paumben) Pass, derived from the survey and remarks by Mr. Morris Chapman, late I. N., Assistant Superintendent of Marine Surveys, in charge of the survey.
11	300	Bay of Bengal . . . . .	Regarding the Andaman islands.
12	300	Red Sea . . . . .	Contains sailing directions for Jeddah harbour.
13	300	Red Sea . . . . .	Navigation. In shore passages.
14	300	Red Sea . . . . .	Regarding dangers in the Red Sea.

74. A tabular statement, shewing the cost of erection of all the light-houses and light-vessels in British India, together with their positions, distinctive characteristics, &c., and cost of maintenance during the year 1874-75, 1875-1876 and 1877-78, inclusive, was completed and issued during the year. Application has been made to the various Governments for the cost of maintenance of the light-houses and light-vessels under them during the year 1878-79, and I

Issue of a descriptive list of Indian light-houses and light-vessels.

have already been favoured with some information. These particulars, as soon as complete, will be published in slips, in order that they may be attached to the statement which has been issued. As I am now making a tour of inspection of all the light-houses and light-vessels on the coasts of British India, and have obtained much valuable information regarding them, I shall, with the permission of the Government of India, issue during the ensuing official year a revised statement which will contain the latest information on the subject, and, I have no doubt, be extremely useful for reference.

75. In addition to the above-mentioned descriptive light-list, a small list of the light-houses and light-vessels in British India, including the Red Sea and Coast of Arabia, is prepared and issued by the Marine Survey Department every year. This is an important contribution to Indian nautical publications, and is corrected annually; the astronomical positions are carefully considered and various alterations and additions are made from time to time, embracing the latest information that can be obtained from the various Marine authorities at all stations between Suez and Singapore.

76. A Return of Wrecks and Casualties in Indian waters during the year 1878 was prepared and issued by Mr. R. C. Carrington, the Registrar of Wrecks, and was highly appreciated by the nautical public. The information necessary for the compilation of this return was regularly forwarded to this office by the various Marine authorities, Master Attendants, Port officers, &c., who also courteously supplied Mr. Carrington with valuable meteorological memoranda, which enabled him to make the return much more elaborate and comprehensive than those previously issued. It is hardly necessary for me to direct the attention of the Government of India to the great difference existing between the Wreck and Casualty Reports formerly published and those now issued from this Department.

77. The following suggestions were made by the Registrar of Wrecks in his review attached to the return, regarding (1) certificates of competency of masters of native craft; (2) the appointment of Port Officers as Divisional Officers for the purpose of personally obtaining on the spot details of wrecks and casualties, and reporting them to the Marine Survey Department; (3) Courts of Enquiry and the necessity of having a legal officer to assist the public prosecutor at such Courts; (4) ship-surveying and unseaworthy ships; (5) the compulsory supply of correct official charts to all ships before leaving a port; and, lastly, the importance of incorporating meteorological memoranda in future returns of wrecks and casualties. I am glad to be able to mention that the above suggestions met with the approval of the Government of India, and that they have received the consideration of the Legislative Council, and of the special Committee appointed to report upon the Indian Merchant Shipping Bill of 1880.

78. From Appendix G it will be seen that since April 1875, the date on which work was commenced at head-quarters, till the 30th September 1879, 58 new charts have been compiled, and 20 Hydrographic Notices, 109 Notices to Mariners, 3 editions of the Return of Wrecks and Casualties in Indian waters (1876—1878), 4 editions of the list of light-houses and light-vessels in British India (1876—1879), and other publications have been issued for the benefit of the nautical community. I have great satisfaction in reporting that during my tours of inspection of the ports on the Coromandel and Malabar coasts and in British Burma applications were made to me by various shipping agencies and masters of vessels for our publications, and these are now being constantly demanded not only throughout India, but also in Europe, whence requisitions for them have been sent to us.

79. It was suggested by the Department of Revenue, Agriculture and Commerce that instead of publishing our Hydrographic Notices and Notices to Mariners as at present in Government Gazettes and public newspapers at Calcutta, Madras, and Bombay, it would be expedient to start a *Marine Survey*

*Gazette*, priced low, either as a separate supplement to the *Gazette of India* or as a separate publication in which all such notices should appear, and copies of which should be available at the different Gazette Offices of all the Maritime Provinces. Besides this the notices were to be posted up in the usual places, and copies sent to all the Port Officers, Chambers of Commerce, &c., to whom they are now furnished. It was believed that this plan would have secured some saving in the cost of printing the notices, and would bring together in a convenient form the information regarding navigation issued by the Marine Survey Department. Having been requested, in communication with Mr. Dean, the Superintendent of Government Printing, to give the suggestion my full consideration and to express my views in the matter for the information of the Government of India, furnishing at the same time an estimate of the net as well as the gross expenditure which the proposal would cost if carried out, and the saving if any that would be secured, I reported that the proposal was, in my opinion, a most admirable one, and that the publication of a *Hydrographic Gazette of India* would supply a considerable amount of information to Marine officials and the sea-faring public, a large number of whom seldom see the official Gazettes. I also pointed out that such a publication would be of very great value, and do more to disseminate useful nautical information than any other means, and that the system of publishing Hydrographic information in a separate pamphlet has been adopted by all the Hydrographic Departments throughout the world, England alone excepted. In conjunction with Mr. Dean it was ascertained that the annual cost of printing 400 copies of the gazette would amount to about Rs. 792. The publication was to consist of 8 pages, to be printed on one side of the page only (a system at present adopted in France, Germany, America, Spain, &c.), so that paragraphs could be cut out and pasted into books of sailing directions, or on to charts without destroying the printed matter on the other side of any page in the paper, and was to be issued fortnightly. The annual expenditure for publishing our notices in the *Gazette of India* and the Calcutta Newspapers was found to be about Rs. 4,122, and it was thus ascertained that a yearly saving of nearly Rs. 3,330 would be effected in Calcutta alone if the gazette was published. I was unable to ascertain the cost of publishing Notices to Mariners in the Gazette of the Government of Bengal, and I mentioned that at Bombay, Madras, and British Burma large sums are expended in advertising them in the local papers as also in the Government Gazettes, but the amount so spent was unknown to me; it was therefore pointed out that a considerable saving would be effected by the publication of the Gazette, and a large sum could be realised by its sale to the nautical community in the above-mentioned presidencies. I was, however, ultimately informed that, on a full consideration of the subject, the Government of India was not disposed to sanction the publication of a separate Hydrographic Gazette.

80. In January 1879 I informed the Government of India that the strength of the Marine Survey Department is now much below par, and that out of eleven sanctioned posts in the different grades, five are vacant. Since that time the number of surveyors has been further decreased by the death of Mr. Morris Chapman, which necessitated the abolition of No. 2 (Madras) Survey Party, and should any other officer become ill or be removed by death the survey work would be much crippled. In consequence of the paucity of surveyors the outturn of work is considerably reduced; officers on high pay and large experience have to perform the duties which others on lower pay should be entrusted with, while no juniors are being trained and gaining experience which would render them competent to undertake the duties and fill vacancies in the higher grades when they became vacant. As it was found that naval surveyors from the Hydrographer's staff could not be obtained for employment in the junior grades of the Indian Marine Survey, I pointed out that it is of the greatest importance that we should ensure there being no great gap in the seniority of officers in the survey (for seniority *ought* to be the test of experience in surveyors), and therefore that two at least of the vacancies should be filled up if possible, and provision

Scheme for filling up vacancies in the Department by the appointment as Cadets of young gentlemen from the training ship *Worcester* or *Conway*.



made for the eventual admission periodically of a class of young men (who might be styled cadets) who have received a good preliminary nautical and mathematical education with a subsequent grounding in theoretical nautical surveying.

81. One source from which young men possessing the desired acquirements as to educational and nautical training could be obtained, is the training ship *Worcester* or the *Conway* (for the sons of gentlemen), and I recommended that Her Majesty's Secretary of State should be asked to give nominations, as vacancies occur, for cadetships in the Indian Marine Survey; these to be competed for or otherwise bestowed on young gentlemen who have finished their course of study in those vessels. In selecting the nominee, special regard was to be had for those who are proficient in free-hand and map-drawing, in the use of nautical and astronomical instruments, and who are good observers and computers. I expressed the hope that the Lords Commissioners of the Admiralty would consent to allow these young men to go through a season of training in marine surveying at the Royal Naval College at Greenwich, a similar boon having been granted to officers of the Indian Navy thirty-five years ago, when they were admitted to study gunnery on board H. M. S. *Excellent* at Portsmouth, and obtained certificates of proficiency on passing out.

82. The number of cadets kept on the strength of the Department was not to exceed two, and was to be regulated by vacancies in the 3rd grade of Assistant Superintendents, *i. e.*, whenever, by promotion, a vacancy occurred in the 3rd grade, a cadet was to be appointed. To become eligible for promotion to the 2nd grade, they were to have passed in navigation and seamanship for Mates, whilst for the 1st grade they were to pass for Master in the Mercantile Marine.

83. I informed the Government of India that the cost of the above scheme could be defrayed from the existing Budget of the Department, and by carrying it out work could be performed with greater efficiency at less expense. My proposals were approved by Government, and were at first recommended for the favourable consideration of the Secretary of State; but I was subsequently informed that in view of the existing financial pressure the Secretary of State has been asked for the present to postpone action in the matter.

84. The Chart Depôt now established in Calcutta has worked satisfactorily and is becoming well known to English and foreign masters of vessels and the various shipping agencies in Calcutta, Madras, and Bombay. Printed lists of all new charts and hydrographic publications, and information as to where these productions are to be purchased, were distributed by us to the shipping agencies in the above presidencies and British Burma, as also to ship-masters who called at Calcutta, and the result is very satisfactory; for not only has the sale of Admiralty publications in store in the Department increased, but the charts of Indian ports and anchorages, published at the office of the Indian Marine Survey, are in much demand and are highly appreciated. Not only is this a fact in respect to British and foreign ships, but a large number of native ship-owners, tindals and nacodas of native craft, are gradually learning the value of being able to obtain such reliable information concerning their own coasts. As many nacodas informed me that they were not aware that charts could be purchased in Calcutta, nor indeed of the existence of the Marine Survey Department, the following notice was printed in Urdu, Arabic, Persian, and Bengali, and distributed amongst all the native shipping agencies in Calcutta, and copies were sent to the various Port Officers and Shipping Masters throughout India, as also to Her Majesty's Political Residents at Bushire, Muskat, Kutch, and Rajkote. Copies were also forwarded to shipping agencies at Baghdad, Bussorah, Jiddah, Bushire, and Muskat, and were distributed to masters of native craft at those and other minor ports.

*"To Nacodas, Tindals, and Masters of Native Sea-going Vessels.*

"Charts of every description, of the Red Sea and Gulf of Suez, of the Persian Gulf, Maskat and Bushire, and of all the coasts and ports of India, may be

purchased at a very small cost at the Office of the Marine Survey Department, 4-4, Hastings Street (close to Government House), Calcutta.

“Nakhodas, Tindals, or Masters of native craft should not go to sea with old and incorrect charts, when they can be obtained at such a trifling cost.

“Those who wish to gain any information about charts, or be directed in matters relating to the navigation of the Indian seas, should apply at the office as above, and enquire for Mr. Carrington, the Superintendent of the Chart Branch.”

85. The following statement shews the number of copies of Charts issued from this Department during the years 1878-79 (*i. e.*, from 1st April 1878 to 30th September 1879) for the use of Her Majesty's and Indian Government ships and the various Marine authorities throughout the world :—

	No. of copies.
Supplied to Her Majesty's and Indian Governments ...	270
Supplied to Foreign, Colonial, and Local Governments ...	298
Presented to Geographical Societies, Survey Departments, Superintending Engineers, &c. ...	546
Supplied to Her Majesty's and Indian Government Ships ...	397
Supplied for official use to the Superintendents of Marine, the various Master Attendants, Port Officers, Harbour Masters, and other Marine authorities in India...	1,505
Presented to the various Hydrographic Departments throughout the world ...	422
Supplied on commission sale ...	781
Supplied gratuitously to Members of the Pilot Service...	60
Supplied to the Superintendent of Marine Surveys, whilst on official tours, to the Marine Survey parties, and for office use in the construction of new Charts ...	313
<b>TOTAL</b> ...	<b>4,592</b>

Of this number, 4,070 were copies of charts produced at the Marine Survey Department, and the remainder, 522, were Admiralty charts.

86. Many ship-masters are supplied with charts direct from the office at head-quarters, where hydrographic information, not obtainable elsewhere, is also furnished, and I have received many acknowledgments from the maritime public of the practical utility of such an office, and of the great boon it is to know where reliable charts and such information are procurable.

87. During the period under review the following sales of charts, &c., were effected :—

	Number of copies.	Rs. A. P.
Indian Marine Survey Charts ...	577	
Admiralty Charts ...	493	
<b>TOTAL</b> ...	<b>1,070</b>	<b>1,708 15 6</b>
Books and other publications, such as Hydrographic Notices, Notices to Mariners, Light Lists, &c. ...	3,637	488 3 0
<b>TOTAL AMOUNT REALISED BY THE SALE OF CHARTS, &amp;c.</b> ...	<b>.....</b>	<b>2,197 2 6</b>

*Official changes, and good services of the Officers of the Department.\**

88. Staff Commander J. H. Ellis, R. N., Deputy Superintendent of Marine Surveys, 1st grade, resigned his appointment from the 10th June, 1878 when he left India.

89. Consequent on the resignation of his appointment by Staff Commander Ellis, Navigating Lieutenant F. W. Jarrad, R. N., Deputy Superintendent of the 2nd grade, was appointed to officiate as Deputy-Superintendent of the 1st grade, with effect from the 25th September, 1878; and consequent on Navigating Lieutenant G. C. Hammond being obliged to give up his appointment on account of ill health, Navigating Lieutenant E. W. Petley, R. N., who had been Officiating as Assistant Superintendent of the 1st grade, was confirmed in that grade with effect from the 25th September 1878.

90. Mr. R. C. Carrington, Superintendent, Compiling and Drawing Branch, was appointed to hold charge of the office of Deputy Superintendent of the 2nd grade, in addition to his own duties, with effect from the 11th June 1878.

91. It was my painful duty to report, for the information of the Government of India, the death at sea on the 24th May 1879, of Mr. Morris Chapman (late Indian Navy), the Senior Assistant Superintendent of Marine Surveys of the 1st grade, who was granted two months privilege leave in the orders marginally noted, to enable him to proceed to Australia for the benefit of his health. I am bound to record my high appreciation of Mr. Chapman's services. He was held in honour and esteem by all who knew him personally. His loss is severely felt in the Department in which he did most excellent work, and where his death is regretted by the officers who were employed under him. Mr. Chapman was a painstaking and laborious surveyor, and always did his duty thoroughly and willingly.

92. Navigating Lieutenant T. C. Pascoe, R. N., Assistant Superintendent, 2nd grade, was granted\* two months and 26 days privilege leave, of which he availed himself on the 1st August, 1879 and proceeded to England.

93. I must again record my satisfaction with the good and valuable work done by Navigating Lieutenant F. W. Jarrad, R. N., and Mr. Morris Chapman, late Indian Navy, the officers in charge of the survey parties, and whilst praising them, I should state that the surveyors noted in the margin were brought to my notice as having done good service.

94. It is, perhaps, unnecessary for me to repeat the opinions I have already frequently expressed of Mr. Carrington, but I cannot refrain from reiterating the remarks made in my letter to the Department of Revenue, Agriculture and Commerce relative to this gentleman. "The special

knowledge and experience which had been acquired by Mr. Carrington during his long service under the Admiralty, which knowledge and experience formed the ground of his selection for this Department as my Chief Civil Assistant in the office, have proved of singular value, not only in the Chart Department but also in the discussion and settlement of the many questions of all kinds which have arisen from time to time in connection with the projection and execution of coast surveys. During his residence in India, his knowledge of the Indian coast, and of the requirements of eastern navigation has been matured, and his practical acquaintance with nautical matters besides his thorough business habits and ardent zeal have rendered him, as stated in paragraph 25 of my general report for 1876-77, a most useful co-adjutor and the greatest acquisition to the office of the Marine Survey Department. I have indeed constantly

\* Mr. Donald Sunder, Chief Clerk and Accountant, again deserves special notice for the manner in which he has conducted his many arduous and responsible duties, which have very much increased during the last year. He has been most indefatigable in keeping the current work up to date and I wish to record my appreciation of his ability, steadiness and conscientious zeal. The clerks under him have continued to give satisfaction.

utilized his services outside the sphere of the particular duties indicated by his present official designation, and I have invariably found him ready and willing to render me the most valuable assistance." Mr. Carrington's qualifications are so high, his industry is so unflagging, his duties and responsibilities are so great, and the manner in which they are discharged so admirable, that the results of his labours at home and during his residence in India have been fully recognized by the respective Governments, and have received my high appreciation.

*Staff of the Marine Survey of India.*

95. On the 30th September 1879 the strength of the Marine Survey Department was as follows :—

Superintendent of Marine Surveys ... Commander A. Dundas Taylor, I.N.,  
F.R.G.S.

*Superintendent's Office.*

Superintendent, Compiling and Drawing Branch.	Robert C. Carrington, Esq., F.R.A.S., F.R.S.L., A.I.C.E.
Chief Clerk and Accountant ...	Mr. Donald Sunder.
Clerk ...	Ishan Chunder Das.
Copyists ...	{ Bidhoo Bhushun Dey. Mr. D. Lumsden.
Head Draftsman ...	Kally Dass Seal.
2nd Draftsman ...	Mr. Thomas Ribeiro.
3rd " ...	Mr. Thomas Smith.
Apprentice Draftsman ...	Rajendro Nath Palit.
" " ...	Pulin Behary Dutt.
Chart Clerk ...	Mr. C. Thielmann.
Chart Moulder ...	Kally Doss Dhur.

One duftary, one duffadar, four peons, and two menials.

*Executive Staff of Scientific Officers.*

Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., F.R.G.S.	Officiating Deputy Supdt., 1st Grade, in charge of No. 1 Survey Party.
Navigating Lieutenant E. W. Petley, R.N., F.R.G.S.	Assistant Superintendent, 1st Grade, attached to No. 1 Party.
Vacant ...	Assistant Superintendent, 1st Grade.
" ...	Assistant Superintendent, 1st Grade.
Lieutenant W. H. Coombs, R.N.	Assistant Superintendent, 2nd Grade, in charge of No. 2 Survey Party.
Navigating Lieutenant T. C. Pascoe, R.N.	Assistant Superintendent, 2nd Grade, attached to No. 1 Party.
P. J. Falle, Esq.	Assistant Superintendent, 2nd Grade, attached to No. 1 Party.
Vacant ...	Assistant Superintendent, 2nd Grade.
W. H. W. Searle, Esq.	Offg. Assistant Superintendent, 3rd Grade, attached to No. 2 Party.
Vacant ...	Assistant Superintendent, 3rd Grade.
" ...	Executive Officer.
" ...	Executive Officer.
" ...	Executive Officer.

*Medical Officer and Naturalist.*

Surgeon J. Armstrong, (Bengal Establishment), F.L.S. ... Attached to No. 1 Party.

**A. DUNDAS TAYLOR, Commander (late I. N.),**  
*Superintendent, Marine Survey of India.*

## SECTION II.

### COMPILING AND DRAWING BRANCH.

DURING the period under review this branch of the Department has been fully occupied in the production of several new charts, many of which have been compiled by the Superintendent (Mr. R. C. Carrington). Perhaps the most useful of these are the general sheets of the Bay of Bengal, and the Sea-face of the Sunderbuns, which charts have been constantly demanded by the public. The sheets showing the surveys by Commander A. J. Loftus, of the East coast of the Malay Peninsula, convey to the world for the first time some idea of the nature of the coast, and are a valuable addition to hydrography. One or two of the principal anchorages of this part of Siam have been published, but unfortunately our staff of draftsmen is not sufficiently large to permit of the preparation of the remainder of those surveyed, for the present, as the publication of the results of our own surveys demands our first attention.

2. The charts of Saláya, Veráwal, Cutch Mándvi, and Preparis north channel have been chiefly compiled from my own observations and surveys, and are useful for local purposes.

3. The finished drawings prepared in the office have been most creditably turned out, and Mr. Carrington reports favourably of all the draftsmen employed.\* It is satisfactory to be able to note that, on the average, one new chart has been produced every month since the Department was brought into working order. Many of these have been compilations from materials hitherto unutilized, and the charts thus produced have proved useful to the coasting trade.

4. During the past 18 months 17 new charts have been published, from which 5,950 copies have been printed; the large number of 17,268 Admiralty and Marine Survey charts have been corrected, and 8,885 copies coloured. The information, enabling this office to carry out these corrections, is derived from the Notices to Mariners and Hydrographic Notices published at the various Hydrographical Establishments throughout the world. England having contributed 368, America 429, Austria and Germany (*Kundmachung für Seefahrer* and *Hydrografische Nachricht*) 253, Holland (*Berigt aan Zeevarenden*) 107, France (*Annonce Hydrographique*) 153, Spain (*Aviso á los Navegantes*) 158, China 24, and the Indian Government 54.

5. The charts in store have been kept corrected up to date, and new lights, beacons, buoys, shoals, &c., are now inserted on all office copies in *red* ink, in order that the corrections made in the Department may be more readily distinguished. Any important corrections that have been found necessary to make on the Admiralty charts, from time to time, have been forwarded to the Hydrographer.

6. The "Return of Wrecks and Casualties in Indian Waters" for 1878 was issued in the early part of the year 1879, and continues to give great satisfaction. Mr. Carrington's "Review" of last year contained many suggestions which I am glad to hear have been considered by the Legislative Council, and in due course, received attention from the Committee appointed to amend the Merchant Shipping Bill for India. Meteorological remarks have been added to the wreck return, which will enhance its value; these remarks will be continued in each annual Report. The correspondence in connection with the subject of wrecks, &c., has unavoidably increased in a most marked manner, no less than 1,188 letters in addition to numerous demi-official memoranda, having been written by the Registrar of Wrecks during the past 18 months, whilst a very large number of reports, returns, proceedings of Courts of Enquiry, &c., have been copied and despatched to the Board of Trade, Lloyd's Agents and others interested in the wrecks and casualties occurring along the Indian coasts.

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\* Babú Kally Dass Seal, the chief draftsman, deserves special commendation for his care and accuracy; Mr. T. Smith has worked well and is now a good hydrographic draftsman.

Mr. C. Thielmann, the chart clerk, is a useful, steady, and hardworking assistant.

7. Another edition (1879) of the "List of light-houses and light-vessels in British India," with an index map showing the positions of the various lights, has been published. Many additions and corrections have been made to the list from my own observations, and the geographical positions have been again carefully scrutinized.

8. A new catalogue of the published charts, plans of harbours, &c., in the Department has also been issued.

*The following statement shews in detail the amount of work performed in this Branch from the 1st April 1878, to the 30th September 1879.*

No. of chart.	Title.	Size.	Scale.	REMARKS.
1190	Ratnagiri, including Mirya and Kalbadavie Bays.	D.E.*	M. = 4'0"	400 copies photozincographed. This sheet shews the result of the survey by Navigating Lieutenants F. W. Jarrad, E. W. Petley and T. C. Pascoe, R. N. and Mr. P. J. Falle, 1878. It cancels the sketch of the anchorage originally published by the Hon'ble E. I. Co., which chart was subsequently corrected and issued at the Admiralty. This is an exhaustive survey of the ports.
1190	Ditto ditto ...	D.E.	M. = 4'0"	An elaborate and detailed drawing. Transmitted to the Hydrographer of the Admiralty.
95	Pámban Pass ...	D.E.	M. = 10'0"	350 copies photozincographed. This sheet shews the survey executed by Mr. Morris Chapman, late I.N., and Lieutenant W. H. Coombs, R.N., 1878. This is an elaborately sounded chart, which can also be utilized for engineering purposes.
1184	Approaches to the Pámban Pass	D.E.	M. = 4'0"	350 copies photozincographed. Surveyed by Mr. Morris Chapman, late I. N., and Lieutenant W. H. Coombs, R.N., 1878. Cancels the original survey made by Lieutenants Powell and Ethersey in 1838. Many newly discovered reefs are marked upon this chart, and the approaches to the pass, north and south, very clearly defined.
177	Hilly Cape to Lacon Bight (on the East coast of Malay Peninsula.)	D.E.	M. = 0'25"	400 copies photozincographed. From the survey by Commander A. J. Loftus, of the Siamese Navy. This coast, hitherto, was entirely unknown, and the sheet fills up a gap on all existing charts. The work has been adapted to the latest reliable astronomical positions, and the general appearance of the land, in approaching the coast, is well shown by the numerous views on the chart.
1191	Rajapur Bay and Viziadurg, with adjacent coast.	D.E.	M. = 5'3"	300 copies photozincographed. This chart shews the result of the survey by Navigating Lieutenants F. W. Jarrad, E. W. Petley, T. C. Pascoe, R.N., and Mr. P. J. Falle, 1878. It cancels the previously existing charts, originally published by the Hon'ble E. I. Co., and subsequently issued at the Admiralty. The whole space embraced within the limits of the chart has been examined in great detail, and the hydrographical portion very closely sounded.
1191	Ditto ditto ...	D.E.	M. = 5'3"	Finished drawing. Shewing the results of Lieutenant F. W. Jarrad's survey in 1878. Transmitted to the Hydrographer to the Admiralty.
1178	Singora Roads (East coast of Malay Peninsula).	D.E.	M. = 4'0"	400 copies photozincographed. This chart is published from Commander A. J. Loftus' survey, made in 1872. It clearly shews the approaches to the port, and is a valuable addition to hydrography, as no chart has previously existed of this portion of the coast.

\* D. E. signifies that the chart is printed on a Double Elephant sheet of paper (i. e., 40 in. X 27 in.), and M-4'0 implies that the scale of the chart is 4 inches to one nautic mile.

No. of chart.	Title.	Size.	Scale.	REMARKS.
115	False Point to Mutlah River shewing the Approaches to the Sandheads.	D.E.	M. = 0·3	400 copies photozincographed. This is a second edition of this chart, which has been found an extremely useful one. The portion between the Eastern channel and Saugor (which includes the Gaspar, Dredge, Bed-fords and Eden channels) shews the result of the late surveys conducted by Mr. Laycock, the river surveyor. Other additions and corrections have been made to the sheet generally.
25	Saláya (Seraia) ... ..	D.E. 2	M. = 1·0	In progress. Compiled from an examination by Commander A. D. Taylor, and the G. T. Kattywar survey sheets, 1879. There is at present no chart of this port, and one is much required for local purposes.
1190	Lacon Bight to Lem Chong Phra on the east coast of Malay Peninsula.	D.E.	M. = 0·25	400 copies photozincographed. This portion of the east coast of the Malay Peninsula, was, until lately, entirely unknown. The present sheet has been compiled from the surveys by Commander A. J. Loftus, Siamese Navy. The coast, with off lying islands, extending over 2½ degrees of latitude, has been drawn in considerable detail, and the chart forms a really useful navigating sheet.
27	Veráwal Roads ... ..	D.E. 4	M = 3·35	300 copies photozincographed. This sheet is a compilation from the surveys by Lieutenants C. G. Constable and A. W. Stiffe I. N. 1853, with additions and corrections by the Veráwal Harbour works Engineer, 1878, and Commander A. D. Taylor in 1879. Hitherto there has been no chart of this port and one was required for local purposes.
103A.	Bay of Bengal. Western sheet...	D.E.	D = 1·85	300 copies photozincographed. Embraces the Western half of the Bay of Bengal, from Cape Comorin to the Hooghly river. This is a compilation from the coast sheets, (Cape Comorin to Cocanada, and Cocanada to Bassein,) originally produced in this Department. The Vizagapatam, Gangam and Orissa coasts being taken from the new chart lately issued from this Office. The Revenue survey maps and the "Atlas of India" sheets have been utilized for the topographical details, and Commander Taylor's corrections and observations along the coast have been added. The most recent Hydrographic information has been inserted, and the work adapted to the latest astronomical determinations.
103B.	Ditto. Eastern sheet ...	D.E.	D = 1·85	300 copies photozincographed. Embraces the Eastern half of the Bay of Bengal, from the Hooghly river to the strait of Malacca. This sheet is also a compilation from the coast charts produced in this Department in 1875-6, and engraved by the Hydrographer to the Admiralty. Many deep-sea soundings have been added from the Admiralty charts, the Sumatra coast has been taken from the latest Dutch charts, and the East coast of the Malay peninsula from the new survey by Commander A. J. Loftus, of the Siamese Navy. The topographical features have been taken from the Revenue survey and other Government maps. The above sheets supersede the charts originally published by the Hon'ble E. I. Co., and since issued by the Admiralty.
	Index Map of India, ...	D.E. 8	D = 0·50	350 copies photozincographed. To accompany the General Report. Shewing the surveys completed by the officers of the Marine Survey Department, and sheets published from the result of these surveys, and those compiled from other authorities.

No. of chart.	Title.	Size.	Scale.	REMARKS.
1217	Approaches to Cutch Mándvi ...	D.E. 2	M = 1·0	300 copies photozincographed. Surveyed by Commander A. D. Taylor; the entrance to Cutch Mándvi river (Bookee river) being taken from the plan of the harbour, (by Mr. T. Ormiston, the consulting Engineer), bound up in his report on the Albert Edward break-water, proposed for the improvement of the harbour of Mándvi, 1876. The chart of the Gulf of Cutch originally published by the Hon'ble E. I. Co., and since issued at the Admiralty, was reported as being incorrect in the neighbourhood of Mándvi and was looked upon with distrust. On visiting the place in 1879, the Superintendent of Marine Surveys was enabled to point out how far the present Admiralty chart was in error and to inform the Hydrographer how that error had arisen. The Admiralty chart has since been corrected. The plan of the place is published for local purposes.
1218	Tuticorin Roadstead and Harbour.	D.E.	M = 4·0	400 copies photozincographed. This chart shows the result of the survey by Mr. Morris Chapman, I. N., Lieutenant W. H. Coombs R. N., and Mr. W. H. W. Searle, 1879. It supersedes the chart published in 1846, by the Hon'ble E. I. Co., and since issued at the Admiralty. It is a well sounded sheet, and clearly shows the approaches to the harbour and anchorage.
137	Preparis North channel and entrance to Bassein River.	D.E. 2	M = 0·80	300 copies photozincographed. This sheet is compiled from an examination made by Commander Taylor in 1879; original charts deposited in this Department, and the latest Government maps. The existing charts, of this part of the coast of Burma, were found to be very erroneous, many dangerous patches of rocks being omitted, and several changes having occurred at the mouth of the Bassein river, while the Alguada lighthouse was wrongly placed on the reefs. The rocky patch on which the ship <i>Inchmarnock</i> struck, was accurately fixed and the Phaeton shoal more clearly defined. The sheet has been much appreciated by masters of vessels, but it must be considered a "preliminary" one only.
115A.	Sea face of the Sunderbuns (from Mutlah River to the Chittagong coast.)	D.E.	M = 0·20	500 copies photozincographed. This sheet has been compiled from Lloyd's original surveys, adapted to the latest astronomical positions. The Chittagong coast from Pearson's and Hammond's surveys and the interior from Government maps. The Eastern portion of the Sunderbuns is taken from the latest Revenue survey maps and shews considerable changes in the configuration of the coast, and the newly formed sand banks at the mouths of the various rivers. The soundings in the Megna, with shoals, and part of the Noacolly coast, are from Mr. Laycock's survey sheets. Great changes are noted on the chart, especially at the entrances to the Ganges.
1231	Kundari island to Chaul	Atlas.	M = 2·0	(In progress.) Shows the survey lately executed by Navigating Lieutenants F. W. Jarrad, E. W. Petley, T. C. Pascoe R. N., and Mr. P. J. Falle, 1879.
1232	Chaul and entrance to Kundalika river.	D.E.	M = 6·0	(In progress.) Ditto.
1233	Jaygad (Jyghur) and entrance to Shástri river.	D.E.	M = 6·0	(In progress.) Ditto.
1234	Dabhol and entrance to Wáshishti river.	D.E.	M = 6·0	(In progress.) Ditto.



No. of chart.	Title.	Size.	Scale.	REMARKS.
	Index chart of Light-houses and Light-vessels in British India for 1879.	D.E. 8		200 copies photozincographed. Bound up with the new edition of the "Light-houses of India."
	Cape Comorin to Point Calimere, including the Island of Ceylon, with plans.	D.E.	M = 0.10	(In progress.) It is intended that this sheet shall embrace the whole of the island of Ceylon. A good general chart of the island, with the adjacent coast, is much needed. Large scale plans of Galle, Colombo, Trincomalee, &c., will be inserted on the spare spaces of the sheets.
	Gulf of Cambay. ...	D.E.	M = 0.50	(In progress.) The present chart of the gulf is a most erroneous one, not only in the hydrographic details, but the coast is greatly in error, and has never been adapted to the positions determined by the Great Trigonometrical Survey. Elaborate surveys within the coast line have been made, and the results published at the Surveyor General's Office, and these will be utilized in this compilation; the hydrographic portion to be inserted, from time to time, as it reaches this office.

Miscellaneous.	For what purpose executed.
Reduction of Commander Loftus' sheet of Singora Roads.	For compilation of Singora chart.
Reduction of portion of Lieutenant Palmer's survey of Bombay Harbour for correction of Admiralty sheet of Bombay Harbour.	For transmission to the Hydrographer to the Admiralty.
Reduction of Gaspar Channel ...	For office use.
Reduction of Lieutenant Hammond's sheet of False Point.	Ditto.
Reduction of River Surveyor's sheet of Dredge, Bed-fords and Eden Channels.	Ditto.
Tracing of Vizagapatam ...	For Commander Taylor.
Copy of plan of Gogah or Gogo ...	Ditto.
Tracing of a portion of Admiralty sheet of the Gulf of Cutch, for additional soundings.	For office use.
Copies of plan of proposed steamer, for sea survey ...	For reference.
Tracing of Dutch Bay, Western Ceylon ...	For transmission to the Hydrographer to the Admiralty.
Reduction of Lieutenant Jarrad's survey of Rajapur and Viziadurg.	For photozincography.
Reduction of Admiralty sheets Nos. 2736, 43 and 42, and Revenue survey maps.	For the compilation of the Saláya sheet.
Reduction of plan of Colombo Harbour ...	For correction of office charts.
Reduction of eleven sheets of Commander Loftus's Siam coast survey.	Used in the compilation of the West Coast of Gulf of Siam sheets.
Additions to the original drawing of Orissa coast sheet.	For photozincography.
Four copies of portion of sheet of Rangoon River showing the proposed re-arrangement of the limits of the Eastern Grove light.	To accompany Commander Taylor's report.
Three copies of proposed modifications of False Point Lighthouse lantern.	Ditto Ditto.
Reduction of Mándvi Roads ...	Compilation of Cutch Mándvi sheet.

Miscellaneous.	For what purpose executed.
Tracing of Cutch Mándvi ... ..	Compilation of Cutch Mándvi sheet.
Ditto ditto ... ..	For Commander Taylor.
Corrections to the original drawing of Kopah Inlet ...	For photozincography.
Copy showing Captain Sayer's additions to Kopah Inlet	For Commander Taylor's use.
Reduction of plan of Veráwal Harbour (by Harbour works Engineer).	For compilation of Veráwal sheet.
Reduction of Admiralty and Revenue survey maps of Dhumrá river, for proposed new survey.	For Port officer, Dhumrá.
Copy of ditto ... ..	For office use.
Copy of Veráwal Roads ... ..	For Commander Taylor's use.
Twelve copies of plan, shewing proposals for screw pile lighthouses at the Sandheads.	To accompany Commander Taylor's report.
Reduction of Commander Taylor's new survey of Alguada reefs and Phaeton shoals.	For correction of office sheet.
Reduction of Admiralty sheets 102a, 102b, 1353, 2760 2414, 2719, 2720, Marine Survey Department sheets 830, 1173, 1179, 1172, 829, 828 and 115; Dutch sheets 94 and 33 and the Revenue survey maps of Burma.	For compilation of Bay of Bengal sheets 103A and 103B.
Copy of plan of Diu ... ..	For Commander Taylor's use.
Three copies, showing portions to be examined in the vicinity of Dhumrá and Mypura rivers.	To accompany Commander Taylor's report.
Corrections to Madras sheet shewing the Harbour works extensions.	For office use.
Copy of plan of Saláya (Seraia) ... ..	For Commander Taylor's use.
Triangulations of Ratnagiri, Rajapur Bay and Vizidurg.	For transmission to the Hydrographer of the Admiralty.
Wreck Chart shewing the wrecks and casualties that have occurred on the coasts of India and Burma.	For binding up with the Wreck Return.
Tracing of plan of Kalkuda and Vendeloos Bays, Ceylon.	For transmission to the Hydrographer to the Admiralty.
Six copies of specimens of buoys in use in India ...	For Commander Taylor's use.
Tracing of Revenue survey map of Borabullung river, Orissa.	For Port officer, Chandbáli.
Tracing of portion of Mr. Chapman's survey of Pámban.	For Major Baird, R.E.
Tracing of plan and sections of Eastern Grove prisms shewing the proposed new light.	For Commander Taylor's use.
Reduction of Pámban Pass ... ..	For compilation of sheet of the Approaches to Pámban Pass.
Diagram shewing Kurrachee tides ... ..	For Commander Taylor's use.
Corrections to the sheet of Narakel Anchorage ...	For office use.
Ditto Colombo Harbour ... ..	Ditto and transmission to the Hydrographer to the Admiralty.
Tracing of plan of Kattywar ... ..	For Commander Taylor's use.
Ditto portion of South Konkan from Bombay to Bankot.	Ditto.
Triangulation of Chittagong Bar, by Navigating Lieutenant G. C. Hammond.	For Port officer, Chittagong.
Corrections to sheet of Beypore ... ..	For transmission to the Hydrographer to the Admiralty.
Tracing of portion of Mr. Chapman's sheet of Tuticorin.	For the Master Attendant's use.

Miscellaneous.	For what purpose executed.
Colonel Fitz Roy's sheet of Pegu and Admiralty sheet No. 152.	For compilation of Prepara's channel sheet.
Three copies of plan of rooms at present occupied by the Marine Survey Department.	For submission to Government.
Noting on charts, the average number and total amount of tonnage of vessels visiting the various ports of India during the past 5 years in order to ascertain what light dues should be levied to make the light-houses, &c., self-supporting.	Ditto.
Six copies of Commander Taylor's additions to False Point Harbour.	For transmission to the Hydrographer of the Admiralty; for Commander Taylor's use, and for submission to Government.
Corrections to Approaches to Bombay Harbour shewing fishing stakes.	For office use.
Tracing of Obbard's, Hammond's, Lloyd's, and Harris's survey of False Point.	To accompany report, also for transmission to the Hydrographer of the Admiralty.
Copy of P. & O. steamers, tracks between Bombay and Aden during the south-west monsoon, for the years 1873 and 1874.	For office use.
Tracing of Approaches to Pt. de Galle Harbour ...	For transmission to the Hydrographer of the Admiralty.
Copy of the above... ..	For office use.
Three copies of General Fraser's proposals for lighting the Sandheads.	For submission to the Government.
Three copies of Commander Taylor's amendment ...	Ditto ditto.
Reduction of Admiralty sheets, Nos. 138a, b and c; 4 Revenue survey sheets, and River Surveyor's sheets.	For compilation of Sunderbuns sheet.



## SECTION III.

### SURVEYING OPERATIONS, SEASON 1878-79.

#### WEST COAST OF INDIA.

THE Government of India in the Department of Revenue, Agriculture and

\* *Vide* letter No. 84 (Marine Surveys), dated the 5th August 1878.

Commerce having approved\* the programme of surveying operations submitted by me at the end of June 1878, I shall state in this section of my report where the two survey parties under Navigating Lieutenant F. W. Jarrad, R. N., Deputy Superintendent of Marine Surveys, and Mr. Morris Chapman, I. N., Assistant Superintendent, 1st grade, were employed, and how the work entrusted to those officers was carried out.

#### No. 1 (BOMBAY) SURVEY PARTY.

2. This survey party at the commencement of the year under review consisted, as in the previous season, of the officers and

Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., Deputy Superintendent, in charge.

Navigating Lieutenant E. W. Petley, R. N., Assistant Superintendent, 1st grade.

Navigating Lieutenant T. C. Pascoe, R. N., Assistant Superintendent, 2nd grade.

Mr. P. J. Falle, Assistant Superintendent, 2nd grade.

Surgeon J. Armstrong (B.A.) F. L. S., Medical Officer and Naturalist.

1 Native Surveyor.

1 Engineer.	4 Lascars.
1 Stoker Syrang.	1 Cook.
2 Stokers.	1 Clerk.
2 Sookhanies.	1 Peon.
2 Leadsman.	1 Taxidermist.
2 Tide Watchers.	

the establishment marginally mentioned, and was furnished with a steam-cutter and a whale boat.

At the beginning of the season, Lieutenant Jarrad was at Bombay, where he had gone to superintend the construction of the surveying steamer *Investigator*, which is building in the Bombay Dockyard, as also to confer with Captain A. W. Baird, R. E., at Poona, on the subject of Indian tidal registrations. During his absence, and as soon as the weather permitted in October, Navigating Lieutenant Petley and Mr. Falle extended the survey of Ratnagiri (which was undertaken during the previous season) one mile to the southward, in order to complete the work to the limits of the sheet sent into this office.

3. On the first occasion, however, on which the steam-cutter was required for sounding she completely broke down, and it was then discovered that many of the boiler tubes had suddenly given out, and that the necessary repairs were of such a nature as to require that the boiler should be placed in the hands of an experienced Boiler-maker. For this purpose Lieutenant Pascoe was immediately despatched with it by coasting steamer to Bombay where, through the kindness of the Superintendent of Marine, the repairs were executed with all possible despatch in the Government dockyard, which enabled Lieutenant Pascoe to return to the surveying ground with the boiler four days after the accident occurred. Meanwhile, Messrs. Petley and Falle finished the soundings at Ratnagiri in a pulling boat. The party proceeded, on the 23rd October, to Jyghur which was one of the ports which His Excellency Sir Richard Temple desired should be thoroughly surveyed.

4. On the 1st November, Lieutenant Jarrad rejoined the party, and surveying operations were at once commenced. During the

*Survey of Jyghur.*

whole of the month the survey of the harbour of Jyghur and its approaches was steadily carried on, and there was no delay as the weather throughout was extremely favourable.

The survey of Jyghur was plotted on a double elephant sheet on a scale of 6 inches = 1 nautic mile, and comprises 21 miles of coast (high water) line and 14 square miles of water closely sounded in sections. The survey extends from the rocky point just below the village of Hedwee (see plan of Bória bay on Admiralty Chart No. 739) southward to Amwah bay (*i. e.*, nearly 5 miles north and south); and from  $1\frac{1}{2}$  miles seaward of Jyghur point to the village of Sytuore (Saichor) on the Shastri river (*i. e.*, 6 miles east and west), and includes the whole of the entrance to that river.

5. The topography here was contoured on the ground.

6. Lieutenant Jarrad reported as follows on the Shastri river, and the capabilities of the port of Jyghur:—

"The Shastri river was, I believe, supposed to be — as with the Wagotna river at Viziadurg—free of any decided bar; but this is not the case, as shoal water, on which there is at low water no where *more than 14 feet*, and in some places *as little as 7 feet*, stretches across its entire entrance. The bar—as indeed are all the obstructing banks in the lower reaches of the river—is composed of more than 70 per cent. of earth (pulverised laterite), and contains only 20 per cent. of sea sand and shell, and 10 per cent. of débris of trap rock, thus clearly demonstrating how seriously the depth of the river must be affected by the quantity of soil washed down by the heavy rains which, in consequence of the sparseness of the vegetation and the wholesale cutting down, for firewood, of trees and even under-growth, finds nothing to bind it, and is, therefore, swept away into the river every monsoon."

7. The harbour, though small, has many natural advantages and is easy of access for vessels of 12 feet draught in all weathers. It also presents features which would render it easy of improvement with but little outlay. There is, however, at present but little traffic on the river, though at Sytuore (Saichor), a village about 4 miles from the entrance, a very large number of pattimars, some of 200 tons and upwards, are laid up and repaired during the south-west monsoon.

8. A leading mark is much required in the Shastri river to guide vessels in the deepest water over the bar; this could be erected at a trifling cost.

9. On the 22nd November, His Excellency Sir Richard Temple arrived in the Indian Government steamer *May Frere* and inspected the harbour, and also went up the river as far as Sangameshwar, distant about 20 miles. His Excellency noticed the shelter the harbour affords in the south-west monsoon, as also the fair amount of anchoring ground obtainable.

10. The necessity for placing all the ports on the South Konkan sea-board under competent control, with regard to proper conservancy, was also brought to my notice by Lieutenant Jarrad, and he suggested that they should be regularly visited, once a year, by an official experienced in these matters, so that any required improvement in buoying or otherwise marking the channels or dangers, may receive proper attention.

11. During the stay of the party at Jyghur the camp was pitched inside the old fortress at that port, and the health of the officers and men was good.

12. The survey was completed on the 7th January 1879, having occupied the party a little more than two months.

13. My arrangement of the sequence in which survey work was to be done *Survey of Washishti (Dabhol) river.* required the examination of the coast between Kundari island and Chaul to be taken up next. But this could not be carried out as a suitable steamer was not available at the required time to convey the survey party to Chaul. The Government had been pleased to place the steamer *May Frere* at the disposal of this Department, and the party was kept at Jyghur nearly three weeks waiting for her; it was, however, subsequently ascertained that the vessel could not be spared as she was being used by His Excellency the Governor of Bombay, in consequence of which Lieutenant Jarrad was instructed to proceed to Dabhol to commence the survey of that river. The instruments, camp equipage, &c., were despatched in a pattimar, and the steam-cutter proceeded up the coast in the early morning before the sea breeze set in, whilst Lieutenant Jarrad went to Bombay and made the necessary arrangements for obtaining the steamer *Dromedary* from

the Port Trust in the event of his not being able to get the *May Frere* to convey the party to Chaul on the completion of the examination of Dabhol. He returned to Dabhol on the 1st February 1879, when surveying operations were commenced.

14. The survey of Washishti (Dabhol or Anjenwil) river extends from  $2\frac{1}{2}$  miles seaward of the entrance as far eastward as Pir Balu, *i. e.*, for 6 miles east and west, and includes the approaches and bar from 3 miles north to  $1\frac{1}{2}$  miles south of Tolakeshwur pagoda (see Admiralty Chart, West Coast of India, sheet No. 738). This survey was most elaborately executed, and was plotted on a double elephant sheet on a scale of 6 inches = 1 nautic mile, and embraces 16 miles of coast (high water) line surveyed and  $11\frac{1}{2}$  square miles of water closely sounded in sections. The topography was contoured on the ground.

15. The shoal water on the bar at the entrance of the Washishti (14 feet the deepest water over) is a great drawback to vessels of any draft entering; but to the small coasting steamers, the new survey will be invaluable, for they can enter, with its aid, at any time of tide, as these vessels draw only 7 or 8 feet and some only 5 feet water. There is no good natural leading mark which can be used for crossing the bar of the Washishti, neither could any beacons or marks be put up for the purpose in consequence of the peculiar formation of the land and its distance from the bar. A buoy, however, might be moored at the tail (on the south side) of the shoal water, which would enable vessels to steer for the channel in safety.

16. The work was much delayed in consequence of the strong northerly winds which blew almost continuously throughout the month, and the heavy sea on the bar which prevented the boats from working.

17. The health of the party was fairly good, notwithstanding that the only camping ground procurable was unpleasantly situated near a mangrove swamp.

18. On the completion of the survey of Dabhol river, the party was conveyed in the Indian Government steamer *May Frere* to Chaul, where they arrived on the 24th March 1879, when work was at once commenced.

19. The survey of Chaul was plotted on a double elephant sheet on a scale of 6 inches = 1 nautic mile, and comprises 20.3 miles of coast (high water) line, and 10 square miles of water very closely sounded over in sections not more than 400 feet apart. The topography was drawn on the ground by the surveyors. By the aid of this survey the small coasting steamers can enter at any time of tide with the greatest confidence. Hitherto the channel and the several dangerous shoals off the entrance were but partially known, and these vessels only entered at from half tide to high water. To ensure vessels keeping in the deep water, however, leading marks are necessary; they could be erected at trifling cost.

20. The survey of the coast between Kundari island and Chaul with the Chaul Kadu reef and other dangerous reefs off Alibag was plotted on a scale of 2 inches = 1 nautic mile, and embraces 15 miles of coast (high water) line examined. The low line and reefs were accurately delineated at spring tides with the exception of certain reefs between Thull and Alibag. These reefs (which consist of numerous small patches of rock with tolerably deep water between) could not be approached in consequence of the heavy sea which constantly breaks on them at that time of the year, caused by the heavy swell from the south-west experienced all along this coast. The reefs, however, are close to the shore, and the shoal soundings on their seaward side were obtained, so that their not being accurately delineated is of little consequence so far as the safe navigation of the locality is concerned.

21. The soundings were taken out to a depth of 7 fathoms, and the whole sheet, which was sounded sectionally, comprises 75 square miles of water closely examined. The villages, topography, &c., on this sheet were taken from the original survey by Captain Jervis (from which Indian Atlas sheet No. 25 was compiled), the principal peaks being fixed by the surveyors; but the southern coast ranges in the vicinity of Chaul were drawn on the ground by the surveyors. The dangerous Chaul Kadu reefs (which were very erroneously placed on the old charts), the outer dangers off Alibag, and several unknown shoal patches off the entrance to Chaul (Kundalika river), all scenes of many a wreck,

are now accurately charted. When our new chart of the Bombay harbour, including this part of the coast, is published, the risk to vessels making for Bombay will be very materially decreased.

22. The Chaul Kadu north-east reef has a stone refuge tower, 60 feet in height, on it. Lieutenant Jarrad recommended that these dangers should be so marked by night as to preclude any chance of a vessel getting into danger with Kundari light in sight, for a bearing of that light is not sufficient to keep a vessel off these dangers. Defective compasses, strong tides and a not too good lookout kept on the bearing of the light would allow a vessel to easily run into danger notwithstanding that these reefs are now well charted, and therefore Lieutenant Jarrad suggests that a red light should be shown from Kundari island westward of the light bearing north (bearing from seaward), that is, over all the foul ground between Kundari island and Chaul. Lieutenant Jarrad's remarks forwarded to the Government of Bombay, by that officer, regarding the exhibition of a *red* ray from the Kundari light will be found in the Appendix E of this report. The Trinity House had recommended this so far back as 1867, before the light-house was built, but it is not known why this very necessary suggestion was not heeded. The Government of Bombay have now approved it, and have ordered it to be carried out.

23. Lieutenant Jarrad also reported the want of means of communication between Kundari island and Bombay. In the case of a wreck occurring in thick weather on any of the off lying reefs westward of Alibag, it might be a considerable time before the casualty would be noticed from the shore. While conducting the survey (in clear weather) a signal was flying at Kundari light-house for 4 or 5 days without its being noticed at Bombay; this signal was to the effect that the light-keepers were without food, and had not the *May Frere* been surveying in the vicinity, this imperfect means of communication might have led to serious results. I would take this opportunity also of bringing to the notice of Government that greater facilities for landing provisions and men, during boisterous weather, are needed at this light-house; indeed this is the one great need at all the offlying light-houses of India.

24. A heliotrope would be of great use in communicating between Kundari light-house and Bombay during the fine season. Flags are, except under very extraordinary conditions of the atmosphere, undistinguishable at such a distance, and at present there is absolutely no other means of communication. The Pilot vessels, it is believed, have orders to communicate with this light-house when such signals *are* seen. The desirability of being able to render speedy assistance to vessels in distress points to the necessity for improved communication with Kundari island.

25. On the 4th May, the fresh S. W. Winds, which are fore-runners of the monsoon, having commenced, Lieutenant Jarrad found it impossible to do any more work, and therefore proceeded with the party to Bombay. The camp and surveying gear were stored in the dockyard, and the boats were hauled up for thorough repair. With the sanction of the Government of India a room was engaged in the Sailors' Home at Bombay, where the party remained for the purpose of plotting and drawing the fair sheets and getting up the season's work.

26. Tidal observations at all the places surveyed by this party were regularly taken, and copies of these have been forwarded for the use of Captain A. W. Baird, R. E., the Superintendent of Tidal and Levelling Operations. Sailing directions and remarks on the whole of the coast surveyed during the year have been issued in the form of a Hydrographic Notice.

27. The surveys were very rapidly carried on as the number of miles completed will show. A large amount of good and valuable work has been turned out and credit is due to all the officers of No. 1 Survey Party.

#### SOUTH COAST OF INDIA.

##### TUTICORIN AND PAUMBEN PASS.

###### No. 2 (MADRAS) SURVEY PARTY.

28. The order in which Mr. Morris Chapman was instructed to execute the surveys under his charge was, as stated in section 1 of this report, first Tuti-



corin, then Cochin and afterwards Beypore, but owing to the bad weather experienced at Tuticorin, and the illness and subsequent death of Mr. Chapman, Tuticorin was the only port surveyed.

29. At the termination of last season Mr. Chapman was instructed to despatch this party to Tuticorin, which was chosen as the recess quarters, in order that surveying operations might be commenced there as soon as the weather appeared favourable.

30. Having left instructions with Lieutenant Coombs, R. N., to proceed with the boats and surveying instruments, &c., and a few men to Tuticorin, Mr. Chapman came, under my direction, to Calcutta for the purpose of plotting and drawing the fair sheets of the Paumben Survey and getting up the season's work, as also to engage a proper establishment for his steam cutter, as many of the men belonging to his party had left, and it was found impossible to fill their places on the surveying ground. The tide watchers declined to remain in consequence of the expensiveness of provisions in the locality, and no individual could be compelled to stay, as the men attached to our survey parties are not engaged on articles. I should here state that it would be extremely unwise for us to employ any person on articles for any particular period as in the event of his proving incapable of doing the special work required in this Department, we should find it impossible to dispense with his services until the expiration of the period for which they were engaged. Meanwhile, the work would be hindered at considerable loss to the public service.

31. Since the time when surveying operations were commenced by boat parties, this party has consisted of only one officer (Lieutenant W. H. Coombs, R. N.) besides Mr. Chapman. When either of these officers became ill, and this unfortunately, as will be seen further on, did happen,—the management of the operations, as a natural consequence, was left to the other officer. But in whatever circumstances these officers were placed they always worked zealously and willingly.

32. The party was provided with a steam cutter and whale boat and consisted of the officers and establishment mentioned in the margin. Mr. W. H. W. Searle joined the party from Calcutta on the 14th March 1879. This officer's services have been lent to the Marine Survey Department from the Indian Marine in consequence of the paucity of surveyors now employed. He had been previously engaged for some time on the surveys of False Point and Chittagong under Navigating Lieutenant Hammond, by whom he was partially trained, and is now proving a useful assistant. The native surveyor sanctioned for this party was not employed, as a suitable person could not be obtained.

M. Chapman, Esq., I. N., Assistant Superintendent, 1st grade, in charge.  
Lieutenant W. H. Coombs, R. N., Assistant Superintendent, 2nd grade.  
Mr. W. H. W. Searle, Officiating Assistant Superintendent, 3rd grade.

1. Native Surveyor.

1 Engineer.	4 Lascars.
1 Stoker Syrang.	1 Cook.
2 Stokers.	1 Clerk.
2 Sookhanies.	1 Hospital Assistant.
2 Leadsman.	1 Peon.
2 Tide watchers.	

33. During the recess, Lieutenant Coombs caused the steam cutter to be thoroughly overhauled and fitted with new tubes, and the whale boat to be repaired, in order that work might be commenced with as little delay as possible at the beginning of the season.

34. Mr. Chapman resumed charge of the party on his return from Calcutta early in September and at once commenced surveying operations. A base of 4,389 feet having been measured, the triangulation was plotted on a scale of four inches = one nautic mile, and the coast line was sketched in on the spot between the triangulated points. The positions of the reefs and shoals were carefully determined, and the sounding work was commenced. The soundings were carried out to the 5 fathom line on the north portion of the sheet, and to the 7 fathom line to the south, *i. e.*, from 2 to 3 miles seaward of the outlying islands. The amount of work completed by this party is shown on one double elephant sheet. During the whole time the surveying party remained at Tuticorin, tidal observations were regularly registered. A copy of these observations was furnished to Captain A. W. Baird, R. E., the Superintendent of Tidal and Levelling Operations, to aid him in the preparation of correct tide tables for the port.

35. Mr. Chapman reported that the weather during the season was exceptionally bad. Strong land winds, with dust, sometimes rendered it very warm and trying to work, and north-easterly breezes frequently necessitated the abandonment of sounding work, which was extremely hazardous in a small steam-cutter.

36. The soundings were reduced to the lower low water of ordinary spring tides, being 6.27 feet below the Great Trigonometrical Survey bench mark cut on a stone at the inner end of the jetty.

37. In consequence of the rough weather at Tuticorin it became necessary to suspend the work there until weather became favourable. Meanwhile Lieutenant Coombs was despatched on the 17th January to Colombo for the purpose of making certain additions to the chart of that port.

*Suspension of the survey of Tuticorin, and additions to the chart of Colombo Harbour.*

38. After our inspection of Paumben Colonel Thomason and I considered that an examination of the water space to the eastward of the shingle islets at that place was necessary.

*Examination of Paumben.*

We had hoped to find a deep water southern entrance to the proposed ship canal through Rameswaram. Mr. Chapman was, therefore, deputed to execute this survey, and the amount of work done by him consisted of 40 miles of soundings, 34 to the southward and 6 to the northward, as also  $5\frac{3}{4}$  miles of coast line sketched in.

39. From this examination we learnt that there are great advantages for a northern entrance to the proposed ship canal, but that a southern deep entrance cannot be obtained.

40. On the 16th March Mr. Chapman became ill at Tuticorin and being unable to carry on the surveying operations there, Lieutenant Coombs was ordered to finish the work.

41. The survey of Tuticorin was completed on the 15th April, and the party under the charge of Lieutenant Coombs proceeded on the 19th April to Beypore, where they arrived on the 22nd April.

*Completion of the survey of Tuticorin.*

42. The health of the party was not good, as two or three of the men were always sick. Among the officers Lieutenant Coombs twice became ill from fever and cold, and Mr. Chapman suffered from inflammation of the liver caused by severe exposure, from which he died before the season closed.

# APPENDICES.

## APPENDIX A.

*General Report on Light-houses by COMMANDER A. D. TAYLOR, late I. N., Superintendent of Marine Surveys, dated Calcutta, the 1st June 1879.*

[Submitted for the consideration of the Government of India, in the Department of Revenue, Agriculture and Commerce.]

The tabular printed statement accompanying this report exhibits, in their geographical sequence (beginning from the west and, going towards the east), all the lights and light-vessels of British India.

The lines printed in italics in the list are my additional notes intended to suggest positions where lights are yet wanted.

1. I was requested, in the beginning of this year, to furnish the Government of India with my opinion on certain proposals of the Marine Department, involving an estimated outlay of nearly 1½ lakhs of rupees annually in the maintenance of a special steamer for inspection and relief of all Indian light-houses. I was likewise asked for my opinion on the general administration of Indian lights; also to say whether I thought any material improvement necessary, and, if so, in what direction.

2. I then submitted a brief reply; but my general report on the subject has been much delayed, because I wished my remarks to be not merely crude surmises, but the result of personal enquiry and observation during this last fine season's tour of inspection. The primary object of this tour, however, was to gather information for the improvement of our charts. I now wish to state my conviction that there is no necessity for employing a special steamer exclusively for light-house inspection and relief, and that the contemplated annual inspection could be managed by sending my Deputy or going myself, partly by land and partly by coasting steamer, to all our lights. The only outlay necessary will be for travelling expenses, halting allowances, and a very few other contingencies.

3. Inspection visits in the hands of the Superintendent of Marine Surveys or of his Deputy,—a Naval Surveyor,—would, moreover, have a triple value. Not only lights, but buoys and beacons also, would come under our supervision. Never do I make a tour without finding out that some light-house, buoy, or beacon is wrongly placed on the chart. The

Santipilly.	Krishna Shoal.
Alguada Reef.	Beyt Island.
Double Island.	Verawal.
China Bakeer.	Cochin.

positions of the light-houses marginally noted were rectified by myself or some officer of my Department. Apparently no official had noticed that the assigned positions were dangerously wrong.

4. If a selected Indian Marine officer (as contemplated by the proposals of the Marine Department) could make these discoveries, how has it happened that the commanders of the Indian Government vessels, which have been constantly plying from port to port for so many years, have failed to report anything as being wrong in the positions of lights or buoys? Many marine officials have ascended the Alguada Reef Light-house and have left their names in the visitor's book, yet they failed to notice the fact that it occupies nearly the south end of the ridge on which it stands, whereas the Admiralty charts have hitherto exhibited it as nearly in the centre. This mistake was left for me to find out on my late tour, although Burma keeps up a salaried Superintendent of Light-houses.

### INSPECTION AND RELIEF.

5. I should say that once a year would suffice for the general inspection; but relieving visits should be undertaken monthly if possible. The only difficulty in a monthly relief would occur at Vingorla Rocks, the Oyster Reef at Akyab, and the Cocos Islands. At times, perhaps in the south-west monsoon, two months might elapse when safe communication is not very easy with the Oyster Rocks off Karwar Bay, with the Alguada Reef, or with China Bakeer off Rangoon; but improved arrangements for landing supplies are possible at all these places. When the relieving officers report that something is radically wrong, speedy measures could be taken to set matters right. The attempt to combine relief and inspection along the coasts of British Burma has resulted in failure, and I think I may add that, had better provision been made simply for more frequent relief and supply, the loss of some few lives might have been prevented.

6. Before submitting any remarks on the administration of Indian lights, it may be mentioned that the Department of Marine Surveys has, since its institution, been instrumental in bringing forward the defects and deficiencies of Indian coast lights in general. Now, I wish to point out the inadequacy of some of the present or former methods adopted in the matter of relief and supply, and some facts which, in the course of my late tours, have been brought to

notice as explaining the principal reasons for failures occurring and for the costliness of the present arrangements at several places.

7. *Firstly*.—Let us take the Bombay Presidency. There never has been any general superintendence of light-houses around its coasts. The result has been that the maritime public, in common with the Marine Survey Department itself, has been kept in ignorance of the existence of many a light, whilst the Admiralty charts have, as a consequence, omitted them. The Commissioner for Salt and Opium, who, for the prevention of smuggling, has a fleet of small craft—schooners and the like—seems to have been permitted to place lights and buoys, or allow lights to be placed by private companies here and there along the Concan coast. Of two or three of these lights we have received no detailed particulars.

8. Native States (notably in Kattywar and Kutch) and private coasting companies have also been suffered to put up lights wherever interportal traffic seemed to demand a light of some sort. Happily, most, if not all, these lights have been well placed and were much needed. Indeed, great credit is due to the several Durbars for supplying those useful auxiliaries to coast navigation.

9. Our List of Light-houses and Light-vessels in British India for the present year (1879) exhibits for the first time several of these lights, the existence of which I have become gradually acquainted with whilst making tours of inspection. And, moreover, not only lights, but buoys and beacons, unknown to any but local authorities and coasters, have thus been (it may be said) *discovered* by me, and subsequently charted and notified in the Sailing Directories, thus clearly demonstrating how important and necessary are official and regular inspections in the Bombay Presidency.

10. The relief and supply of outlying light-houses off the Bombay coast have not proved matters of such apparent difficulty or so exceedingly costly as on the coast of Burma. Indeed, no complaints have (to my knowledge) been published of deaths or lingering sickness amongst the men on the Bombay side. The Vingorla Rocks Light cost only Rs. 2,578 for maintenance in 1876-77; and, although but a fourth order light, it is as far from any port and as inaccessible during the south-west monsoon as the Oyster Reef Light-house off Akyab, or the late Krishna Shoal Light-house, or the China Bakeer off Rangoon river. These three last-mentioned Burma lights cost, respectively, for *relief* only (which excludes pay of light-keepers, provisions, and oil) Oyster, Rs. 8,327; Krishna, Rs. 4,200; China Bakeer, Rs. 2,375.\* The light on the Oyster Rocks at Karwar is more unapproachable than Savage Island at Akyab, or Double Island near Amherst, yet the Carwar *first order* light only cost Rs. 6,200 a year, which sum includes the pay and provisions of an European head light-keeper; whilst the Savage Island *third order* light (on the Burma coast) cost about Rs. 8,900 a year,† with only native light-keepers. Kenery also and the Prongs Light-houses are each as difficult of access as Savage Island at Akyab. The relief of Perim Island Light-house in the Gulf of Cambay, during the south-west monsoon, must present nearly as much danger and difficulty as the relief of either Savage Island or Double Island Lights.

11. *Secondly*.—With regard to the Madras coast lights, there has never been any difficulty in managing the relief and supply of these. But I believe no systematic annual inspection has been carried out till recently, say for three years. During this period several useful alterations and improvements have been effected by the Administrative Branch of the Master Attendant's Department. Fortunately the Revenue Board possesses a small steamer, the *Margaret Northcote*, which is available at a convenient season every year for the Master Attendant to make inspection tours and ascertain any latent defects in the lightage and the requirements of coast navigation as regards lights, buoys, and beacons. Railways, canals, and backwaters, besides the coasting steamers, also furnish facilities of access to all the Madras lights. This Presidency has no outlying light-houses, and the inspection duty is therefore a very simple matter.

12. *Thirdly*.—For the sake of comparison, allusion might be made to Ceylon lights, although not under the Government of India. The Great and little Basses Light-houses are under the superintendence of the Master Attendant of Galle, by whom these structures are supplied with material, relieved, and occasionally inspected without trouble. During the south-west monsoon their relief and supply present quite as great difficulties as are experienced at the Alguada and Oyster Reef Light-houses; but what the maintenance and relief of these lights cost I have been unable to ascertain from Galle, and would suggest that the information be obtained from the Board of Trade.

13. *Fourthly*.—There is apparently no general inspection of the lights in the Bengal Presidency by any marine official; but local port officers seem to manage the relief and supply without difficulty. The existing costly method of lighting the approaches to the River Hooghly, and the practicability of effecting great improvements at a diminished outlay, have been already brought under notice of the Government of India, and are now under consideration. I am confident that an inspection of the Saugor and Cowkolly Lights would result in the substitution of better lights, which would be a boon to the pilots, and the up-keep of which should cost less than at present. I would make the same remark regarding Kootubdeah Light near Chittagong, which was inspected

\* These figures are the means of the amounts given in the reports of the Superintendent of Burma Light-houses for 1876-77 and 1877-78.

† Average of the two last years.

and reported upon by me in January 1877. All these country-made lights and reflectors are less efficient, and cost in their up-keep double or treble the sum which the English dioptric central wick lights require.

14. An effectual inspection of all light-vessels also is, indeed, necessary for the purpose of ascertaining where the blue light is burned. Verbal reports have frequently been made to me that sometimes the

**Bengal light-ships.**

Ridge Light, sometimes the Eastern Channel, or perhaps the Lower Gaspar Light, has not burnt its prescribed blue light while a vessel was approaching. From personal observation, when entering and leaving the Hooghly river, and on nearing the *Star* light-vessel when she was stationed at Krishna Shoal, it has become evident that frequently partial, if not entire, eclipses of the blue light have been occasioned by the fact that it is burnt on the fore-castle at the same elevation as the line of all the ship's awnings (especially when drooped) and behind the quarter boats. It is of much importance that an arrangement should be made to prevent these unsatisfactory occultations of the blue lights. It can easily be done by fixing a light gallery above the boats' davits on each quarter, so that the light may be burned above the boat on the lee side and at considerably higher elevation than at present. The officer in charge of the *Star* light-ship quite concurred with me in this proposal.

15. *Fifthly*.—Alluding to the lights on the coast of British Burma, I would call attention to the fact that these alone of all\* the Indian light-houses are

**British Burma lights.**

maintained by special light-dues levied on shipping, and have a paid Superintendent. Annual reports on the light-houses off the coast of British Burma are published, and from these we gather that an attempt to combine relief with inspection has caused the visitations to some light-houses to be few and far between. The last report (1877-78) says: "Allowing for the drawbacks incident on the want of a steamer, the work of provisioning and manning the various lights has been carried out in a satisfactory manner by the Superintendent." But in the preceding paragraph a complaint is made that, "owing to the want of a proper sea-going steamer, none of the light-houses were visited so frequently as, in justice to the men employed on them or the nature of the work, they should have been."

16. On my recent tour round the coast of Burma, and principally during my stay near Diamond Island, it became apparent to me that it was a fundamental error to commit the responsibility of relieving and supplying all the off-lying light-houses of so extensive a coast as Burma to the hands of one port officer stationed at Rangoon. Take the Alguada Reef Light-house as a case in point. Without a proper sea-going steamer, this station could not certainly be visited from Rangoon so frequently as it should be. Nor could the port authorities at Bassein, being without a steamer, be expected to come down and look after Alguada Light-house. Formerly, there was a relief establishment at Diamond Island. Its cost is not clearly stated in the report for 1876-77, but that for 1877-78 says "the light-house expenses were to a great extent lessened by the abolition of the Diamond Island relief station (the relief now being quartered in Rangoon)." Perhaps Rangoon is the best head-quarters for the light-keepers and men who compose the relief, and for the oil, stores, provisions, &c. Thence they could easily be sent by British India Company's steamer to Diamond Island or Akyab as required.

17. In my opinion, the relief and supply should come as formerly from Diamond Island, but I would not revive the separate costly relief establishment. The pilots should be entrusted with the responsibility of relief, entering into a contract with Government. They have excellent boats, and from their intimate knowledge of the weather† and locality they would never be at a loss to know when to go out. They could establish a system of signals with the light-house, so that not a day should pass without their cognisance that all is well. It is a matter of vital importance to these pilots that the brightness of the light should be permanently maintained. One firm of Bassein pilots have already proposed to carry out this service by contract at a moiety of the present cost.

18. The above system which I have proposed for the relief of Alguada should be applied to all the other Burma light-houses, *i. e.*, they should be relieved from the nearest pilot station. The pilots have a deep interest in seeing that the lights off their respective ports are in proper trim. I cannot now go into all the details, either of expenditure or management. These could best be ascertained on a preliminary inspection tour. Meanwhile, an enquiry might be made whether the Chief Commissioner of British Burma has any objection to the general idea.

19. I propose a preliminary inspection of all the light-houses and light-ships around the coast of India. On such an official tour we should gather

**Preliminary inspection.**

what we now lack in the matter of details regarding the ways and means of supply and relief. Respecting the remarks made above in paragraphs 7 and 8, and further on in paragraphs 22, 23, and 24, the attention of the Bombay Government and of the rulers of the Native States should be invited. But it must be borne in mind that, not only the lights, but the system of buoys and beacons likewise, requires to be scrutinized. Therefore I maintain that none but a Surveyor, supplied with proper instruments, should undertake this important duty. The inspector should be veritably the Marine Surveyor General, or his Deputy. This preliminary coast inspection (as sketched out in paragraph 2) might occupy four or five months of next smooth season, whilst the information gathered at the same time for correcting charts would be invaluable.

\* At Kurrachee and some Native ports, special light dues have been recently levied (see paragraphs 22 and 23).

† Colonel Fraser, R. E., says,—"During the breaks which always occur in every monsoon, at irregular intervals and of uncertain duration, opportunities will occur of landing supplies, provided that means are afforded for facilitating the operation."

## LIGHT-HOUSE ADMINISTRATION.

20. The visits I have already made, coupled with the information to be gleaned from the

Calicut.	Algnada Reef.
Muttum.	Cocos Island.
Pulicat.	Eastern Grove.
Armeghon.	Double Island.
Coringa.	Outer and Inner
Calingapatam.	light-ships,
False Point.	Bombay.
Light-ships of	Carwar.
Hooghly river.	Coompta.
Saugor.	Ratnagiri.
Cowkolly.	Bulsar.
Kootubdeah.	Tapti.
Savage Island.	Tankaria.
	Koonbundar.

descriptive list of lights, convince me that economical alterations may be easily effected at the light-houses marginally named. Some of the alterations consist in improving the present light; others in providing different light apparatus; others again in reducing the establishment and adopting better measures for relief and supply. The question of each should be thoroughly considered by the Inspector and the Port Officer in whose range the light is.

21. Whilst offering now a few proposals for the management of each light-house, I shall briefly state what I gather to be the present average annual up-keep of some lights which are very costly. An enquiry into the methods adopted

for relief which cause so great expenditure of money, might show what saving may be counted upon in the future.

22. Beginning with Kurrachee, it may be remarked that the magnificent new first order dioptric revolving light is entirely in the charge of natives.\*

**West Coast lights.**

My inference is that other lights of India and Burma might be advantageously entrusted to natives when a proper system of inspection is organised. Referring to Kurrachee, it appears that quite recently the Bombay Government has sanctioned the levy of light dues at 6 pies per ton on ships, and of 3 pies per ton on country craft.

23. It would be well if His Highness the Rao of Kutch and the Native Chiefs of Kattywar were invited to allow their several light-houses to be annually inspected. The Durbar of Baroda might also be asked to let

**Lights in Native States.**

the Okhamundel lights at Beyt and Dwarka undergo the general annual inspection. At Kutch Mandvi, Porebundar, and Verawal, light dues have lately been levied which partly recoup the cost of maintenance.

24. All the Government light-houses in the Gulf of Cambay, northward of Bombay, form one group, consisting of Perim Island, Koonbundar, Tankaria, the Tapti Light, and Bulsar. One or two more inexpensive

**Northern group lights.**

lights might be introduced for the improvement of the intricate navigation of this gulf. These lights are under the control of the Salt Department, but are doubtless relieved and supplied from Bombay. They should certainly be subject to some nautical inspection.

25. Bombay harbour, having a Port Trust and Executive Engineers, with a steam tug and launches, is better provided than any Indian port. The

**Bombay lights.**

*flashing light.* All the Bombay coast lights southward of that great harbour are reported to be under the control of the Salt Department. The management of these, as also of the northern group, may be very good,

**Southern group lights.**

but seems to be practically irresponsible; an official inspection would, therefore, be most advantageous. At the same time the Inspector should enter into communication with the Collector of the district and the Sea Customs officers regarding the enforcement upon fishing boats to exhibit distinctive lights at night. I understand the Port Officer at Bombay has succeeded in introducing rules which bind the tindals of native vessels to shew lights at night, as also to make themselves acquainted with the meaning of a ship's red and green side lights. This is a step in the right direction.

26. The west coast of Madras Presidency may conveniently, and indeed properly, be styled Malabar. All the lights thereof were inspected this

**Madras coast lights.**

year by the Master Attendant of Madras, and the general administration of the light-houses in this Presidency appears to be satisfactorily conducted. Nevertheless, the *positions* of all light-houses should be tested by the Marine Survey Department, because most of them have been erected since the coast was surveyed. No special light dues are levied on account of any light under the Madras Presidency. When the system is amplified and improved, there should be no reasonable objection to the imposition of additional light-dues of a small amount. The Governments of the three Indian Presidencies lay out money year after year in increasing the number and efficiency of lights, whilst the port dues (by which the lights are supported) remain at the old figure.

27. This last remark refers in a special manner to the River Hooghly lights. In former days these were indifferent; but, in compliance with the representations of pilots and others, gradual improvements have

**Hooghly river lights.**

been introduced by the Government—a better class of light-ships, more lofty and more brilliant lights, more frequent blue lights, and finally the *Intermediate* light-vessel. These additional aids to navigation have been introduced in the interests of the pilots and of steam tugs; their introduction is an immense personal benefit to the pilot, rendering his work 25 per cent. easier in the fine weather and fully 50 per cent. less risky during boisterous or hazy weather.

**Bengal coast lights.**

The lights of the Bengal Presidency, other than those which mark the entrance to the River Hooghly, appear to be either under the Collector of the district or the Superintending Engineer of the Circle. No systematic annual inspection appears to take place, but would be very beneficial. The Hooghly light-

\* The China Baker light at Rangoon, of the first order dioptric, with a *fixed* and *flashing* apparatus, is also kept up entirely by native light-keepers.

ships and light-houses seems to be partly under the Port Officer and partly under the Superintendent of Marine. A fortnight in every year would suffice for the inspection of all lights in the Bengal Presidency, and by the same opportunity, the buoys and beacons should be examined, and the correctness of their positions tested.

28. It is generally claimed for the coast of British Burma that it is the best lighted portion of the whole seaboard of India. Doubtless a large original expenditure and costly maintenance have been allowed there, whilst special light dues have been legally levied to recoup the money lent by the Government of India. In paragraphs 15 to 18, I have already touched upon these matters, and submitted my idea of a cheaper method of relief and supply for Alguada Reef Light-house, and I have stated that the same principle may be advantageously adopted for all these lights. I shall now proceed to speak of each in turn, pointing out some instances where the maintenance appears to have been extravagant. The permanent up-keep of two or three old schooners seems to have been one reason of the heavy expenditure. Now the pilots are obliged to keep good boats of their own, and it will be much cheaper to hire those boats to carry out the duty of supplying and relieving all out-lying light-houses.

29. The Oyster Reef Light-house, together with that on Savage Island, should be supplied relieved, and provisioned from Akyab, and be under the charge of the Port Officer there. Every opportunity of fine weather could then be taken advantage of in communicating with the keepers. The annual report for 1878 says that "owing to the distance of the Oyster Reef Light-house from Rangoon, it will still be convenient to maintain a schooner at Akyab, partly for port purposes and partly to act as a tender to the Savage and Oyster Reef Light-houses during the fine weather." I venture to think the Akyab pilots would contract to supply and relieve more efficiently and economically both the Oyster Reef and Savage Island. The report shews that nearly Rs. 8,000 (this does not include provisions, stores, and oil) were spent in 1877-78 in relieving and inspecting the latter island. Seeing that it lies inside Akyab river entrance, the above must be considered an unreasonable expenditure; indeed, it represents *two-thirds* of the entire cost in maintenance of the Savage Island Light for the year 1877-78. If we look into the table shewing receipts and disbursements of light-houses, we shall also see that the relief and inspection of the Oyster Reef amounted to nearly Rs. 10,000 or about two-thirds of its entire up-keep.

30. Double Island Light-house should be under the Port Officer of Moulmein, and be relieved, supplied, and provisioned by the pilots at Amherst. These men are continually cruising down in the neighbourhood of Double Island, and could choose their own fine weather. From the report for 1876-77, it appears that the cost of relief and inspection amounted to Rs. 4,115, whilst the total up-keep of this light station was Rs. 9,726. For 1877-78, the cost of relief, supply, and inspection was only Rs. 848 and the up-keep Rs. 5,864, that is to say, through some extraordinary management during this year the relief charges were only one-fifth of the expenditure of the previous year.

31. With regard to the old Krishna Light-house, a few remarks should be made. The report for 1876-77 shews an expenditure of Rs. 8,159 for relief and inspection, out of a total cost in maintenance of Rs. 13,845; that is to say, the staff of men employed with their provisions, and the cost of oil and other stores, amounted to Rs. 5,186, whilst an outlay of Rs. 8,159 was incurred in communicating with the light-house. The report attributes this large expenditure to the fact that the *Ava* steamer was pronounced unseaworthy in June 1876, and in December of that year was sent to Calcutta; therefore, "*since that time the work of visiting and supplying the light-houses with stores, &c., has been done by chartered steamer at a large expense.*" Yet the total cost of the Krishna's up-keep during the previous year 1875-76, when the services of the *Ava* were made use of, is stated as Rs. 14,275. From this it would appear that the adoption of hired steamers is economical rather than otherwise.

32. Eastern Grove and China Bakeer Light-houses should, of course, be under the Port Officer of Rangoon. The latter structure, though on piles, is on the margin of the river, and quite dry at low water. Why such expense should be incurred in relieving, supplying, and visiting a place of this sort is, indeed, incomprehensible. In 1876-77, the establishment, provisions, oil, and stores cost Rs. 4,857, whilst it took Rs. 4,079 to deposit the oil, stores, and provisions there and to relieve the men, besides enabling the superintending officer to go there occasionally and see that the place is in good order. It is satisfactory to hear, but difficult to understand, how the above relief only cost Rs. 746 in 1877-78.

33. China Bakeer Light-house, standing in 12 feet of water at lowest tide, is not so accessible as the Eastern Grove Light, yet it is easier to approach than the Krishna, the Alguada, or the Oyster Reef. The relief, &c., of China Bakeer in 1876-77 cost Rs. 4,150, but in 1877-78 it is set down as only Rs. 762. If the latter low figure was maintained during the financial year of 1878-79, it will be very creditable to the superintendence.

34. Let us now consider the Cocos light on Table Island. It is rather remarkable that for three months after the death of that unfortunate European light-keeper, the natives kept the light going satisfactorily. The apparatus is dioptric of the first order, and consumes only half as much oil as the Alguada. Considering the above circumstances, and that the China Bakeer, a dioptric *flashing* light of



first order, is maintained solely by natives, there can surely be no good reason for employing a European at the Cocos when a proper system of relief, supply, and visitation has been instituted. More than half the cost of establishment could be saved by entertaining only natives.

35. I would put the Cocos light under the Port Officer of Port Blair, whilst the British India Company should be invited to tender for its relief, provisioning, and supply. Every month their steamer proceeding to the Andaman Islands passes the light on her way from Calcutta to Port Blair, and, by making a slight detour on her voyage between Port Blair and Rangoon, she has two opportunities of calling at Cocos every month, so that if the weather be bad at one time it may be fine a few days afterwards. Now, we have the fact that from the beginning of October 1877 till January 1878, no visit whatever was made to this out-lying light station. Again, in April last, the Cocos light-keepers seem to have been in want of oil and took advantage of the fortunate appearing of a passing sailing ship to let some of their wants become known.\* We learn this from a Moulmein newspaper. At the Cocos they have a farm-yard, besides a garden which keeps the men supplied with fruits and vegetables. In 1876-77, five trips for visitation and relief, including inspection, cost Rs. 5,227; but in 1877-78, the five trips cost Rs. 2,354 only.† Surely some improved arrangements are called for in this administration of light-houses.

36. It is impossible to find out the exact expenditure in maintenance of each light. The Accountant General gives us the total outlay upon the *Pharos* and the *Dauntless* tenders, whilst the Superintendent of Light-houses apportions the cost of these vessels to separate light-houses. Thus in 1876-77, according to the Superintendent, the *Dauntless* only helped the Alguada Reef, whilst half the up-keep of the *Pharos* was apportioned to the Krishna Light-house, and one-sixth of the same was debited to each of three lights, namely, the Eastern Grove, the China Bakeer, and Double Island.

37. In 1877-78 the *Pharos* had been got rid of altogether. The Superintendent now debits half the cost of the *Dauntless* to Oyster Reef Light and the other half to Savage Island. It is reasonable to infer from this that he found out and adopted some new way of relieving the Eastern Grove and China Bakeer, both being at the mouth of the Rangoon river. It may be that this relief was effected by means of the Government steam launch which the Port Officer now has. Perhaps, also, the relief of Double Island, which in 1877-78 cost only about Rs. 550, might have been effected through the agency of the pilot boats at the contiguous station of Amherst. It will be interesting to see whether in 1878-79 such a comparatively inexpensive method was maintained.

#### SUGGESTIONS AND PROPOSED IMPROVEMENTS.

38. The Bombay Government has under consideration a proposal to run a steam ferry-boat across the Gulf of Cambay from some point in Guzerat to one in Kattywar. I was asked to give my opinion on the subject, and, after visiting two or three of the places mentioned, I have reported that the mouth of the Kim or Kantiajal river (not far from Bhagwa, where the present postal sailing boats cross the Gulf) appears to be the best Guzerat terminus, but a small light will be absolutely needed there. I lately received a petition from a number of nakodahs or tindals of the native craft trading in Cambay Gulf as to the advantage of another light or two on the Guzerat side, owing to the difficulty experienced in navigating between the treacherous sandbanks. If I had the *May Frere* for a month in November next, I could go thoroughly into this question and inspect all the lights and buoys.

39. The systematised light-house arrangement at Bombay and the excellent plan adopted there of placing stone beacons on rocky shoals inside and off the harbour, might be introduced at other Indian ports. If a light-house (as proposed) be built on the Sunk Rock, both the inner and outer light-ships may be dispensed with and a great annual saving effected. As the Port Trust has a Mechanical Engineer who is competent to fit and repair the modern style of light apparatus, I submit that advantage should be taken of this, and that his services be lent to other stations if required. He was lent to Kurachee when the new revolving light was put up.

40. The Master Attendant of Madras proposes to place Cannanore light on a brick pedestal in substitution of the present method of carrying it at the flagstaff masthead, where, being thoroughly exposed to the wind, the light cannot be trimmed in blowing weather; neither do the light-keepers feel inclined to ascend the mast at such times. This light is complained of as being generally dim, and I quite agree with the Master Attendant's suggestions. About Calicut light, I have already written to Government in letter No. 6 (Lights, Buoys, and Beacons), dated 11th January 1879. A new dioptric light with lantern might cost Rs. 3,000, but I am convinced that a saving of Rs. 300 per annum in maintenance might be effected by its introduction, to say nothing of increased efficacy. There ought to be a small light at Beypore which steamers arriving there by night might set as a cross bearing to Calicut.

\* The Commander of the French barque *Cardinal Donnet*, just arrived, reports that on the passage to Moulmein, and when abreast of the Cocos on the 13th April, he saw and noted the following signals from the light-house:—

“ (C. P. S. T.) Communicate the following :

“ (F. C. V. E.) I am in want of

“ (K. C. T.) Oil for lamps.

“ A subsequent signal was not understood.”

† The expenses incurred during 1877-78 for contingencies, including steam hire, &c., are given by the Superintendent's report as Rs. 1,343.



41. Near Alipee in Travancore, where the mud bank now lies, a small cross light should be shewn from the shore abreast. The need of this light should be brought to the notice of the Travancore Government. The mud bank has moved down southward and is now off Porcaud, about 9 miles below Alipee, but the smooth anchorage is only marked by a buoy, which is no guide at night.

42. With regard to Muttum (Cadiapatum) Light, I would remark that the new first order dioptric apparatus has been lying at Madras or Tuticorin for a long time, whilst a temporary light only is exhibited at Muttum. If the Government of India erect the necessary building, I think the Travancore Government should maintain the light, because it can be utilised for Kolachel on the one hand and for Cape Comorin on the other. As the cause of delay in putting up the new building, I am given to understand that the Public Works engineers want to build a lofty light-house, the cost of which would absorb all the money allowed and leave none for the light-keeper's residence, which *must* be built. A tower of 40 feet in height is ample, the land at Muttum being elevated from 80 to 100 feet above sea. A costly first class light also was proposed for Cape Comorin by Mr. Dalrymple, late Master Attendant of Madras, but I thought that subsequent discussion as to the necessity of such a light had quite exploded the idea. In my proposals for the general improvement of coast lightage, there might be a third or fourth order dioptric light, *fixed* and *flashing*, on the Cape.

43. When the trade of the south of India becomes more developed by its railways, or when more depth is obtained in the Paumben Pass, or if ever a deep-ship canal be made through Rameswaram Island, additional lights will be wanted in the Gulf of Manar and Palk Strait. There is a great trade with Jafnapatam in the north-east monsoon, but the north end of Ceylon has not a single light. I think the Colonial Government might be invited to consider the advisability of putting up a fourth order light at Kangasenthoray, which is the landing place for Jafnapatam during the south-west monsoon.

44. The light suggested for Calymere Point would be a useful one. It has been proposed also to fix a country lantern of the second class to mark the Coleroon Shoals between Nagapatam and Pondicherry; but I trust all these country-made old-fashioned reflectors will be discarded. Whenever also a new light is erected, the Marine Survey Department should send an officer to fix its position exactly. On my last visit to Cocanada, I found that the new Vakalapudi Light-house is built in the rear of several palmyra trees, whereas the chosen site indicated to us was seaward of all the trees.

45. With regard to the Pulicat Light, I would remark that, if made a white light, it would be better seen from ships off Pulicat Shoal. Madras Light being flashing, there can be no objection to this change. Moreover, let the Armezhon Light exhibit *red* to seaward and over the shoal, whilst showing *white* to those vessels which may wish to run behind it from the northward, having a cargo to land near Pudi.

46. Many complaints have been made of the badness of Coringa or Hope Island light. I believe the mischief lies in its being merely a (so-called) first class country-made apparatus. A light of the central wick style by Chance Brothers, even of the third order merely, is far preferable to a country-made affair. I think, therefore, that a visit should be made to Coringa Light-house with the express object of ascertaining, by actual measurement and under engineering advice, whether the structure could not be made to carry, perhaps, a third order heliophotal catadioptric light. The cost of maintenance of the present light is about Rs. 3,000 annually, whilst I may quote that of Colombo, with a second order dioptric light, as Rs. 1,500.

47. A small *red* light was formerly exhibited from the top of the Dolphin's Nose (the high headland which shelters Vizagapatam on the south side). This light was destroyed during the cyclone of 1876, and has not since been replaced, the best locality for a light being a moot point. My opinion is that if the Port Officer's flagstaff exhibited a sixth order harbour light the necessity of the case would be cheaply met. As a vessel approaches the port from the southward, this light would only become visible when bearing to the westward of N. W., but from the knowledge that it appears in sight on that bearing, there could be no mistake. The advantage of a light on the flag-staff is that at night a vessel would steer for it on a certain bearing, whilst the lead would tell when the vessel was near enough to anchor. I think Bimlipatam should have a small sixth order light shewn from the terrace of a bungalow, throwing a *white* light over the anchorage, but *red* over ground where vessels should not anchor. It has been already recommended, and the Madras Government agrees that a more powerful light should be put on Conadah hill to guard the Santipilly Rocks.

48. The contemplated improvement of False Point Light by the substitution of a new first order *fixed* dioptric apparatus will be a great boon to navigators. I think that the entrance to Dhumra river which leads to Chandbally should have a small light. At present there is no land-mark to indicate Palmyras Point or the sandy island at the river mouth. Hitherto there has been a beacon on Shortt's Island, but it has been blown down. Before reconstructing this it would be well to consider if a small light could not be erected. The trade of Balasore would be greatly benefited by a light near Palmyras Point.

49. I have already said a few words about the light-vessels at the Hooghly mouth. As a committee is investigating the question of the substitution of screw-pile light-houses for light-ships, nothing more need be said at present, but I would refer the reader to paragraph 14.

50. A new interportal trade has sprung up between Dacca district and Chittagong. I consider that a small light of fifth order might advantageously be put up at the south-east point of Sundeeep Island, or on the

mainland to the northward of Chittagong, to guide vessels into shelter behind Sundee. It has also long been acknowledged that a better system of lighting the approaches to Chittagong is needed and a pile light-house on the South Sands seemed to be generally preferred by mariners. But I pointed out to the Government of Bengal that, before deciding on any position for a new light, a thorough survey of the whole neighbourhood is necessary. The Kootubdeah Light-house has to be protected during every south-west monsoon from the encroachment of the sea at high water. This proves that it is a great mistake to place a stone structure on sand where the waves have (if only for a total of four hours daily) access to it.

51. There is a rising trade at the Naaf river in Arakan, and, when the entrance has been surveyed, a site should be chosen for a landing light to guide small vessels inward. An Act of the Government of India

**Burma coast lights.**

has recently been published, whereby the special light dues leviable on the coast of British Burma are increased to  $1\frac{1}{2}$  annas per ton. I believe this tax is over and above the port dues, which are heavier on this coast than elsewhere. I think, therefore, when the present expenditure on the lights of Burma is looked into (*see* remarks at paragraph 10), it may be found that enough money is levied to pay for the up-keep of one or two more little lights.

52. The Oyster Reef Light might be utilized for entering and leading across the bar of the Myou river, which lies landward of the light-house. A green or red ray could be exhibited from the Oyster Light, and the cost would be very trifling. However, nothing could be carried out till the entrance of the river has been examined and partially surveyed.

53. Alguada Reef Light-house is most expensive in regard to its up-keep, simply because the apparatus is complicated. It has four faces, each face having four distinct lights, each with its own small dioptric annular lens for  $180^\circ$  with silvered reflector at the back. These sixteen lights must need the services of more men than Chance Brothers' central wick lamps require. Good as it undoubtedly is, I should recommend the substitution of a Chance Brothers' second order flashing light as being equally powerful whilst more economical. Natives only could then be employed, so that an annual saving of Rs. 4,500 in establishment and provisions, and at least Rs. 500 in oil, might be effected. In five years this saving would pay for the new apparatus, whilst the dismantlement of the light would give us sixteen excellent little catadioptric coast or port lights, each shewing  $180^\circ$  of arc. The lines printed in italics in my tabulated statement shew that we require a few more small lights to complete the chain around the entire shores of British India. Here we have a store of light apparatus only requiring lanterns which can be made cheaply in India. Where  $180^\circ$  of arc is not enough, two of them may be put together. Where one superior light is needed over  $180^\circ$  of arc, three of these may be brought together and will be very effective. I venture to submit the consideration of this proposal to the Government of India. It would be well to ascertain what is the actual consumption of oil at each light-house. In the reports, the items of expenditure for oil and other things are mixed up together.

54. Enquiry into this question would show whether my proposals are reasonable or not. From an elaborate "Report (1867) on the means of illuminating sea coast and harbours," written by Colonel A. Fraser, R.E., C.B., we learn that—

"the combination of the spherical metallic reflector with the annular lens was applied by Mr. Thomas Stevenson, C.E., to the Alguada Light-house. The only reason it was employed by the Government of India was the fear of the single light of the dioptric system going out, while there are sixteen lights in the frame of the revolving apparatus of the Alguada Reef Light-house, any one of which remaining unextinguished would still be useful to the mariner. But I think an examination of the nature of the dioptric lamps used will cause all fear of any such accident happening to the single light of the dioptric system to be discarded. The lantern and light apparatus and revolving machine of the Alguada Reef Light-house cost £3,500, while a first order dioptric light, with eight annular lenses, giving a similar effect, would cost in France about £2,720, and in England about £2,872; so that while we enjoy at a higher price a light, perhaps, not equal, *even as a revolving light*, to the dioptric light of the same character, the materials employed are of an inferior nature, both as regards liability to deterioration and solidity of construction, while the annual cost of maintenance and the difficulty of looking after and keeping up the flames of sixteen lamps to a proper height is of course greater."

55. The signalling arrangements at the Alguada Light-house are now very bad. They want a much larger cross-yard, to be placed at a more favorable angle for reading the flags from Diamond Island. Signalling by heliograph should also be introduced here and at all other off-lying lights. Carrier pigeons might advantageously be tried; the keeping of them would occupy the idle time of the light-keepers. At present they seem to have no way of signifying their distress, except by darkening the light towards Diamond Island; but this process might lead to fatal results when a steamer is coming out of Bassein by night and her pilot reckons on seeing the revolving light.

56. The sad loss of the Krishna Light-house with several lives should teach us the importance of taking soundings periodically on certain lines away from such structures, and of putting down those soundings on paper for report to superior authority. I have informed the Government of India of the partial examination which we made in the *Hugh Rose* of shoal water on the Krishna, and my remarks might be copied here.

"On the 1st February I proceeded from Madras to Rangoon; there, according to previous arrangements with the Marine Department, the I. G. S. *Hugh Rose* awaited my arrival. I took that vessel to the Krishna Shoal, across which I ran several lines of soundings. This examination satisfies me that the shoal remains of much the same form as depicted on the chart. The I. G. S.

*Ava* is said to have sounded all round the spot very shortly after the screw-pile light-house was missed, and it was officially reported then that the soundings taken gave a depth of 6 fathoms all round at low water.

"I found no such depth anywhere near. The *Star* light-vessel is anchored 4 miles to the eastward of the position formerly occupied by the light-house. She is in  $4\frac{1}{2}$  fathoms at low water of spring tides. The *Hugh Rose* sounded away from the *Star* on two lines: firstly, N.-W.-by-W.- $\frac{1}{2}$ -W., on which course, at half a mile off, we had 4 fathoms (reduced); thence the water gradually shoaled till at  $2\frac{1}{2}$  miles the depth was 10 feet (reduced); this was the shoalest water found, and the breadth of it was only 100 yards. Afterwards, the water gradually deepened till at  $1\frac{1}{2}$  miles further on the same course we had  $4\frac{1}{2}$  fathoms (reduced); this was in the well-known channel between the shoal and the shore.

"The second course we steered from the light-vessel was W.-S.-W. Near the vessel we had  $4\frac{1}{2}$  fathoms (reduced); thence gradually shoaling we had 3 fathoms at 3 miles off and  $2\frac{1}{2}$  fathoms at 4 miles from the *Star*. This least depth (15 feet) was maintained for 10 minutes, which proves that the shoalest south part of the Krishna is nearly a mile broad. At  $5\frac{1}{2}$  miles from the *Star* we had 3 fathoms, and at  $7\frac{1}{2}$  miles we again deepened to  $4\frac{1}{2}$  fathoms. From this last position we stood on the same course W.-S.-W., but did not get 6 fathoms (reduced) till we were 10 miles from the light-vessel.

"I firmly believe that search was not made at the right spot; neither (from what I hear) was it made by the right method. Moreover, I think it very likely that a few days' search with the *Hugh Rose* next January or February might result, even at this late date, in our hooking some portion of the submerged structure."

57. With regard to lighting the entrance of the Moulmein river, I may mention that formerly a blue light was burnt at Amherst, which the commanders of vessels, when arriving, utilized as a cross-bearing to fix their position when off the bar. This was discontinued some few years ago, but several of the commanders of the British India Steam Navigation Company urged that it might be revived, and Lieutenant Jarrad, when he made an exhaustive survey of the port, also recommended that a permanent red light should be exhibited for the above purpose. I fully concur in Lieutenant Jarrad's proposal, notwithstanding the opposition to this improvement which the Marine authorities of Burma have raised. It cannot be said that the entrance of the important river of Moulmein is sufficiently lighted.

#### SUMMARY.

From the foregoing remarks it will be seen—

(1). That an annual outlay of  $1\frac{1}{2}$  lakhs of rupees for the maintenance of a special steamer for inspection and relief of Indian light-houses is unnecessary.

(2). That the work of inspection can be better and more economically done either by myself or my Deputy (a naval officer), and that at the same time additional information concerning buoys, beacons, &c., might be gathered for the correction of our charts and for the safety of navigation.

(3). That an official inspection is necessary. That all light-houses and light-ships should be inspected at least once a year, but relief should, if possible, take place monthly.

(4). That the present administration of light-houses throughout India is imperfect, and that the cost of maintenance and relief of the Burma lights has been excessive and appears extravagant.

(5). That many economical alterations might be effected—

(a).—In the employment of Native instead of European light-keepers.

(b).—In making alterations to the lighting apparatus whereby the usefulness of the light would be increased and the consumption of oil considerably diminished.

(c).—In adopting better measures for relief and supply, including improved means of landing men and stores during boisterous weather.

(6).—That several new but small lights are necessary in various parts of the coast; but their utility, or the positions they should occupy, can only be determined in a preliminary inspection of all the light-houses.

(7). That this inspection could be carried out next cold season and a report furnished of the actual requirements of each light or port.

## List of Light-houses and Light-ships

## INDIA, WEST COAST—

No.	Name of light.	Location.	Character and order of illuminating apparatus.	Colour of light and height above Sea.
1	Kurrachee (Sind Coast) ...	On S.-W. bastion of Manora Fort; W. side of harbour entrance.	D. 1st Ord. ...	White, 150 feet...
	<i>Indus Banks</i> ...	<i>Just inside the Hajamri mouth</i> ...	<i>2nd Order Holo-photal.</i>	<i>White, 80 feet ...</i>
2	GU P OF KUTCH { Mandree ...	S.-W. bastion of Fort ...	D. 4th Ord. ...	White, 115 feet...
3		At the edge of the mangrove swamp, south of Tekra Island.	Common lantern	White, 17 feet ...
4		On Roji temple, N.-E. part of Roji Island, at mouth of Nowanaga Creek.	3 common kerosine lamps.	White, 42 feet ...
		<i>Seraia Bandar</i> ... <i>East end of Chanka reef</i> ...	<i>3rd Order</i> ...	<i>White, 70 feet ...</i>
5	Beyt or Bate ...	The highest and nearly the central part of Sainia Island.	D. 4 Ord. ..	White, 35 feet ...
6	Dwarka ...	On the rocky point west of the town, 350 feet within the high-water line.	3 common kerosine lamps.	White, 70 feet ...
7	Porebandar ...	On a tower at the water-gate of the town wall	D. 4th Ord. ...	White, 85 feet ...
8	Mangarol ...	On the highest square house, 400 yards from landing place.	Country lantern	White, 60 feet ...
9	Veráwal ...	On pier head, N.-W. side of harbour ...	D. 4th Ord. ...	White, 56 feet ...
	<i>Diu Head</i> ...	<i>On the rocky cape which is 50 feet high</i> ...	<i>3rd Order dioptric</i>	<i>White, 80 feet ...</i>
10	Jáfrábád ...	Mouth of creek, south side ...	6 kerosine lamps	White, 70 feet ...
	<i>Shial Bet or Chauch</i>	<i>Near the mouth of Pipalwas creek</i> ...	<i>3rd Order</i> ...	<i>White, 70 feet ...</i>
11	Mowa ...	On the terrace roofing of the light-keeper's residence, situated on a prominent cliff near the entrance of Mowa Creek.	C. 4th Ord. ...	White, 99 feet ...
12	Goapnath ...	On a hillock, 240 yards in-shore of Goapnath Point.	D. 6th Ord. ...	White, 68 feet ...
13	Perim ...	On the ruins of an old bastion on the island ...	D. 4th Ord. ...	White, 100 feet...
14	Gogo or Gogah ...	On the beach near the Custom House ...	Large ship's lantern.	White, 25 feet ...
15	Bhaunaggar ...	On the south shore of the creek ...	C. 4th Ord. ...	White, 48 feet ...
16	Khunbandar ...	4½ miles S. by E. of the entrance to Dholera Creek and westward of the <i>Bore Rocks</i> .	Common lantern with 5 oil-burners.	White, 50 feet ...
17	Deojugan or Tankari	North shore, mouth of Dhadhar River ...	Common lantern with 6 oil burners.	White, 49 feet ...
	<i>Nerbudda</i> ...	<i>Broach point or Jageshwar</i> ...	<i>D. 5th Order Holo-photal.</i>	<i>White, 50 feet ...</i>
18	Bhagwadandi ...	On the low point of Dandi Creek entrance ...	Large ship's lantern.	White, 40 feet ...
	<i>Kantiagal</i> ...	<i>South bank of Kim Creek near Karang village</i> ...	<i>D. 5th Order signal light.</i>	<i>White, 35 feet with Red and Green cuts.</i>
19	Tapti ...	Near Vaux's tomb, on north shore, indicating entrance to the Surat River.	D. 4th Ord. ...	White, 91 feet ...
	<i>Domus</i> ...	<i>On Domus flagstaff</i> ...	<i>D. 5th Order signal light.</i>	<i>White, 50 feet with Red and Green cuts.</i>
20	Bulsar ...	Mouth of the Bulsar or Oranga River ...	Common lantern with 3 oil burners.	White, 50 feet ...
21	Outer light-vessel...	In 6 fathoms, 4½ miles S.-S.-W. from Kolaba Point.	C.	Red, 36 feet ...

## around the Coasts of British India.

## BOMBAY PRESIDENCY.

Fixed, flashing, intermitting, alternating or revolving.	Miles visible in clear weather.	Nature of construction, colour, or any peculiarity of light-house.	Height, in feet, of building from base to vane.	REMARKS.
Rev. 2 minutes.	20	Round tower of white stone...	52	During the fair-season only, i. e., from 30th September to 1st June, a temporary <i>red</i> light is shewn at the extremity of the breakwater, to facilitate the entering of steam vessels into the port at night. <i>The dangerous Indus banks ought to be marked.</i>
<i>Fixed.</i>	16	<i>Screw pile</i> ... ..	...	
F.	18	White masonry tower above the fort wall.	56	Constructed and maintained by His Highness the Rao of Kutch.
F.	6	Stone ... ..	23	
F.	7	Round tower. White ...	50	
<i>Flashing.</i>	13	<i>Stone tower</i> ... ..	55	<i>This light will greatly benefit vessels going to Nawanaga and Jooria as well as mark the entrance to Seraia.</i>
F.	12	Stone masonry. White ...	18	Erected at the cost of His Highness the Gaekwar.
F.	6 or 7	Square stone. White ...	25	A new <i>dioptric</i> light of the 4th order will shortly be exhibited.
F.	15	Small white tower above gray stone tower of fort.	20	The light was purchased by, and is maintained at the cost of, the Rana of Porebandar.
F.	12	Square house top ...	52	A small port light.
F.	13	Masonry. White ...	40	The light was purchased by, and is maintained at the cost of, His Highness the Nawab of Junagarh.
<i>Revolving.</i>	16	<i>Masonry</i> ... ..	30	<i>The S.-W. point of Kattywar requires to be marked.</i>
F.	10	Wooden shed ... ..	42	The light was purchased, and is maintained, by the Nawab of Junjira, who owns Jáfrábád.
<i>Fixed.</i>	14	<i>Stone</i> ... ..	40	<i>His Highness the Thakore of Bhaonaga is going to put up a light.</i>
F.	13	Masonry. White ...	27	For local purposes only.
F.	6	Buff-coloured, limestone masonry tower.	32	The light has been erected specially to mark the Goapnath reef.
F.	15	Round brick tower ...	78	
F.	5	On a post near the flagstaff...	...	A small Post Office light.
F.	8 or 9	Timber frame. White ...	54	For local purposes only.
F.	10	Wooden piles. Conical ...	50	Exhibited from the 1st September to the 15th June only.
F.	10	A mast fixed in masonry ...	.....	Exhibited from the 1st September to the 15th June only.
<i>Revolving Holophotal.</i>	12	<i>Masonry tower</i> ... ..	40	<i>To guide vessels into Broach River and improve the navigation of the Gulf of Cambay.</i>
F.	5	A small mast on a sand-hill...	.....	This light, in charge of the Postal Department, is exhibited only when the mail boats are expected to arrive from the opposite side of the Gulf of Cambay.
<i>Fixed.</i>	8	<i>Timber frame</i> ... ..	40	<i>To supersede the Bhagwa-Dandi.</i>
F.	15	Circular brick masonry tower, 3 bands red and white.	60	The light-house is on a sand-hill.
<i>Fixed.</i>	7, white 5, color.	<i>Flagstaff top</i> ... ..	.....	<i>To mark Tapti bar and the best anchorage.</i>
F.	10	Wooden piles. Conical ...	50	Exhibited from the 1st September to the 31st May only.
Rev. 20 seconds.	10	Wooden vessel of 201 tons, painted red, with a red ball at mast-head.	.....	Marks the fairway or mid-channel, between the Prongs and Thull Shoal. A <i>blue</i> light is burnt every hour, and a torch every half hour. A <i>red</i> flag is hoisted when a vessel is seen.

## List of Light-houses and Light-ships around

## INDIA, WEST COAST—BOMBAY

No.	Name of light.	Location.	Character and order of illuminating apparatus.	Colour of light and height above sea.
22	Inner light-vessel...	A quarter of a mile S.-E. $\frac{1}{4}$ -E. from Sunk Rock	C.	White, 33 feet ...
23	<i>Sunk Rock</i> ... Prongs ...	<i>In the water over Sunk Rock</i> ... On S.-W. portion of reef extending south-westward from Kolaba; the rocks at the base of the light-house dry at low water.	..... D. 1st Ord. ...	<i>White, with red cut</i> White, 136 feet...
24	Dolphin ...	On the rock ...	D. 5th Ord. ...	Green and white, 20 feet.
25	Tourbah ...	Custom House Pier ...	.....	White, 12 feet ...
26	Kennery or Khundari ...	On the island ...	D. 1st Ord. ...	White, 161 feet
	<i>Bankote</i> ...	<i>In the river's mouth</i> ...	<i>D. 5th Order signal light.</i>	<i>White, 35 feet</i> ...
	<i>Dabhol</i> ...	<i>On Anjenwil headland</i> ...	<i>D. 5th Order</i> ...	<i>White, 130 feet</i> ...
27	Ratnagiri ...	South bastion of fort ...	D. 4th Ord. ...	Red, 312 feet ...
28	Rájapur or Jaitapur ...	On the cliff at the south point of Rájapur Bay	D. 6th Ord. ...	White, 99 feet ...
29a	<i>Viziadurg</i> ...	<i>On East side of fort</i> ... Melundi Harbour. On the beach, 230 yards north of a white stone cross.	<i>D. 6th Order</i> ... A ship's side light	<i>Red, 50 feet</i> ... Green, 20 feet ...
29b	<i>Malwan</i> ...	Light-boat, situated to the south-east of the rock at the entrance to the harbour.	A ship's riding light.	Red, 8 feet ...
30	Vingorla Rocks or Burnt Islands.	On the summit of the outer or westernmost rock.	D. 4th Ord. ...	White, 100 feet...
31	Vingorla ...	On mainland, 1 mile west of the town ...	D. 6th Ord. ...	White, 250 feet...
32	Goa (Portuguese) ...	Aguada Fort, on hill above landing place, about a mile from outer port.	C.	White, 280 feet...
33	<i>Marmagao</i> ... Oyster Rock or Carwar (Shedashigar Bay).	<i>On the fortress wall</i> ... On the summit of the Oyster Rock	<i>D. 5th Order</i> ... D. 1st Ord. ...	<i>White, 30 feet</i> ... White, 210 feet...
34	Konay, near Beikul Cove (Carwar Bay).	Exhibited from the Port Office ...	Ship's port side light.	Red, 65 feet ...
35	Coompta (Cumta) ...	Conical hill at mouth of creek, about $1\frac{1}{2}$ miles from the town.	Common lantern, with 5 burners.	White, 181 feet...

## INDIA, WEST COAST—

36	Mangalore ...	On a hill above the town, and near some high trees.	D. 4th Ord. ...	White, 240 feet...
37	Cannanore ...	In the old fort, on red ground ...	D. 6th Ord. Chance's Port or signal light.	Red, 96 feet ...
38	Tellicherry ...	On the fort wall, near the beach ...	D. 6th Ord. Chance's Port or signal light.	White, 95 feet ...
39	Calicut ...	On the sandy beach ...	1st class country-made, with brass reflectors.	White, 102 feet...
	<i>Beypore</i> ...	<i>From Railway Station</i> ...	<i>D. 6th Order signal light.</i>	<i>Red, 25 feet</i> ...
40	Cochin ...	On a small mound which formed a bastion of the old fort, to the south of the harbour.	C. D. 4th Ord. ...	White, 100 feet...

## The Coasts of British India—continued.

## PRESIDENCY—continued.

Fixed, flashing, intermittent, alternating or revolving.	Miles visible in clear weather.	Nature of construction, colour, or any peculiarity of light-house.	Height, in feet, of building from base to vane.	REMARKS.
F.	10	Wooden vessel of 158 tons, painted red, with a red ball at mast-head.	43	A guard for Sunk Rock. A red flag is hoisted when a vessel is seen.
..	Ordered	to be built to supersede		Lies N.-E. $\frac{1}{2}$ N., 5 miles from outer light-vessel.
Fl.	20	Masonry. Circular bands of white, red, white and black.	146	<i>the Light-vessel.</i>
10 seconds.				The principal light at Bombay, erected on the Prongs Reef, with dangers extending $1\frac{1}{2}$ miles E. by S. through south to W. by N. from the light-house.
F.	3	Masonry tower. Grayish with white dome.	35	The white light indicates the anchorage for the English mail steamers at night.
F.	5	Lantern on a pole.		
F.	20	Octagonal masonry tower, on centre of a flat-roofed house.	75	A flagstaff, with yard, 200 feet high, stands N.-E. by N. from the light-tower.
Fixed.	8	Timber framing.	30	To guide vessels over the bar during the fine season only.
Revolving.	13	Masonry white tower.	20	To mark Dabhol and Anjenwil and to benefit coasting vessels.
F.	8 to 10	Masonry tower. White ...	23	Intended as a guide to coasting steamers and country craft making the port.
F.	9 $\frac{1}{2}$	Masonry tower. White ..	21	The light is not exhibited during the S.-W. monsoon, i. e., from the 11th June to 9th September.
				Intended as a guide to coasting steamers and country craft making for either Rájapur Bay or Viziadurg.
Fixed.	4	White building on the fort wall	10	To lead into Viziadurg.
F.	...	Exhibited from a post ...	.....	A vessel running into the port should keep the green light just to the right, or open south, of the red light, passing close to the southward of the red light, thereby avoiding the rock awash the Malwan and Johnston Castle-rocks.
F.	5	Wooden boat.		
F.	12 to 15	White tower on square building.	31	
F.	9	Mast ... ..	39	The lights will not be exhibited between the 15th June and the 31st August.
Rev. 1 min. and 50 sec.	12	Circular. White masonry tower.	53	
Fixed.	9	On fort wall ... ..	5	To guide vessels into Marmagao.
F.	25	Circular. White masonry tower.	72	
F.	6	Flagstaff. White ...	.....	With the light bearing E.-S.-E. a vessel can anchor in from 5 to 3 fathoms.
F.	10 to 12	Masonry column. White ...	60	

## MADRAS PRESIDENCY.

F.	14	Small, white masonry tower	65	
F.	6	Flagstaff ... ..	50	Harbour light.
F.	8	Flagstaff ... ..	38	Harbour light.
.....	12	White column ... ..	100	To guide vessels to the anchorage clear of the reef which lies about 1 mile S. 30° W. from the light.
				A small red light is exhibited from the T. head of the pier as a guide for small coasting craft when entering the port.
Fixed.	4	On top of hotel or Port Officer's Office.	30	To mark Beypore.
F.	15	White laterite column ...	91	During the S.-W. monsoon, when Cochin port is avoided by shipping, a small light is exhibited from a flagstaff, at Narakel, about 5 miles to the northward of Cochin.

*List of Light-houses and Light-ships around*  
INDIA, WEST COAST—MADRAS

No.	Name of light.	Location.	Character and order of illuminating apparatus.	Colour of light and height above Sea.
41	Alipee or Alleppy ...	On the sandy beach, about one cable inland, close to the flagstaff.	Holophotal ...	White, 113 feet...
42	Muttum (Cadiapatam) ...	Situated upon high red-coloured land, 300 yards from the sea, which is here fringed with steep gray cliffs.	1st class country-made.	White, 105 feet...
43	Cape Comorin ...	On the Cape ... ..	.....	.....

ISLAND OF

44	Colombo ...	Clock-tower, centre of fort ... ..	D. 2nd Ord. ...	White, 135 feet...
45	Point de Galle ...	On S.-W. bastion of fort. West side of harbour.	C. 2nd Ord. ...	White, 100 feet...
46	Great Basses ...	On the N.-E. rock ... ..	D. 1st Ord. ...	Red, 110 feet ...
47	Little Basses ...	On reef ... ..	D. 1st Ord. ...	White, 110 feet...
48	Batticaloa ...	On the flagstaff, near the mouth of Batticaloa Lake.	A large dioptric lantern.	White, 50 feet ...
49	} Trincomalie ...	On Foul Point extreme ... ..	D. 2nd Ord. ...	White, 104 feet...
50		On the summit of Round Island ... ..	D. 4th Ord. ...	White, 103 feet...
		<i>On the sandy beach</i> ... ..	<i>D. 4th Ord.</i> ...	<i>White, 40 feet</i> ...

INDIA, EAST COAST—

51	Tuticorin ...	North extreme of Hare Island or Paundiantivo, 2½ miles east of Tuticorin.	D. 4th Ord. ...	White, 85 feet ...
52	Paumben Pass ...	On a sand-hill, about one mile east of Northern Channel.	C. D. 4th Ord. ...	White, 97 feet ...
53	Calimere ...	On the point ... ..	.....	.....
54	Negapatam ...	On bastion ... ..	D. 4th Ord.	White, 79 feet ...
55	Karikal (French territory)	At the mouth of the River Arselaar ... ..	Lantern with 3 burners and reflectors.	White, 34 feet ...
56	Coleroon (Porto Novo) ...	.....	.....	.....
57	Pondicherry (French territory).	In square, near the beach ... ..	.....	White, 89 feet ...
58	Madras ...	On esplanade, north of the fort ... ..	C. D.	White, 124 feet...



## the Coasts of British India—continued.

## PRESIDENCY—continued.

Fixed, flashing, intermitting alternating or revolving.	Miles visible in clear weather.	Nature of construction, colour, or any peculiarity of light-house.	Height, in feet, of building from base to vane.	REMARKS.
Rev. bright flash every minute.	20	Masonry ... ..	115	This light is in the territory of His Highness the Maharaja of Travancore, to guide ships to the smooth water anchorage in the vicinity during the stormy weather on this coast from May to November.
F.	12	Square, brick masonry. White.	23	This light, in the territory of Travancore, is intended to mark the vicinity of the Crocodile Rock, which bears from it S.-W., distant $2\frac{1}{2}$ miles.
.....	.....	..... .	.....	The light-keeper's and Mission bungalows are white buildings with thatched roofs. <i>Proposed.</i>

## CEYLON.

F.	18	Brick masonry, square, gray-looking building.	112	A life boat station. Harbour light for vessels making the port.
F.	12	Iron tower. White ...	80	For vessels making the port.
Rev. 45 seconds.	16	Granite masonry tower with a gallery 30 feet above the base, and another immediately beneath the lantern. The lantern has a conical roof.	127	A first class light is sanctioned for this port, and will be placed on Oonawatty Point.
Int. two flashes a minute.	16	Granite masonry tower with a gallery 12 feet from the upper gallery. The lantern has a domed roof.	.....	In foggy weather, a bell is sounded at intervals of fifteen seconds.
F.	8 to 10	Flagstaff ... ..	.....	During thick or foggy weather, a bell is sounded twice in quick succession every half minute.
F. & Fl. 30 seconds.	17	Round gray tower of Portland cement.	120	The light is exhibited from the 15th February to the 31st October, the time during which the port is open.
F.	10	Round gray tower of Portland cement.	69	The faint light between the flashes is visible beyond 10 miles.
<i>Fired.</i>	10	<i>On a mast or a tripod</i> ...	.....	To enable vessels to enter or leave the port at night.
				<i>To mark the place which is the S.-W. monsoon anchorage of Jafnapatam.</i>

## MADRAS PRESIDENCY.

F.	14	Sandstone column, coloured brown, lantern white.	91	Harbour light.
F.	12 to 14	Circular. Masonry column...	72	Is a guide to vessels making for the Paumben Channel.
.....	.....	.....	.....	<i>Proposed</i> that a revolving dioptric light of the 4th order be displayed on this point to enable vessels to steer clear of the shoals which lie across the entrance of Palk's Bay.
F.	14	Masonry column. White ...	83	
F.	8 to 10	Flagstaff ... ..	.....	A port light.
.....	.....	.....	.....	
F.	12 to 15	Masonry ... ..	.....	It is <i>proposed</i> to fix a country lantern of the 2nd class to mark the Coleroon Shoals.
Fl. every two minutes.	20 to 30	Granite column ...	125	For the guidance of vessels entering the port at night.
				Mariners should not bring this light to southward of S.-S.-W. $\frac{1}{4}$ W. to avoid Pulicat Shoal.
				Two <i>red</i> lights (vertical) are shown at the outer end of the north groin of the harbour works, and will continue to be exhibited as the works progress seaward.

## List of Light-houses and Light-ships around

## INDIA, EAST COAST—

No.	Name of light.	Location.	Character and order of illuminating apparatus.	Colour of light and height above Sea.
59	Pulicat ... ..	Near the beach ... ..	D. 4th Ord.	Red, 68 feet ...
60	Armegon or Armogham ...	Mainland, village of Moona or Moonapolium ...	D. 4th Ord.	White, 107 feet...
	Kutlowpatam ... ..	On sandy beach ... ..	D. 5th Order.	White, 50 feet ...
61	Divi ... ..	2 miles N. W. of point ... ..	D. 4th Ord.	White, 48 feet ...
62	Masulipatam ... ..	In the fort ... ..	D. 6th Ord.	White, 69 feet ...
	Narsapore ... ..	On the sandy point ... ..	D. 4th Order.	Red, 80 feet ...
63	Coringa ... ..	On southern part of Hope Island and distant about $2\frac{1}{2}$ miles from the sea.	D. 4th Ord.	White, 83 feet ...
64	Cocanada (Vakalapudi) ...	$4\frac{3}{4}$ miles north of Cocanada River ...	C. D. 4th Ord.	White, 80 feet ...
65	Vizagapatam ... ..	On the headland named Dolphin's Nose ...	.....	.....
66	Santipilly ... ..	On Santipilly Hill, $\frac{3}{4}$ of a mile inland ...	D. 4th Ord.	White, 169 feet...
67	Calingapatam ... ..	On the point ... ..	3rd class country-made.	White, 68 feet ...
68	Gopaulpore ... ..	On mainland, 60 yards from low water mark ...	3rd class country-made.	White, 85 feet ...

## INDIA, EAST COAST—

69	Pooree ... ..	1,400 yards S. $33^{\circ}$ E. of Juggernaut Pagoda	Lantern	White, 45 feet...
70	False Point ... ..	At the entrance to the River Mahanuddy, about $1\frac{1}{2}$ miles west from Mahanuddy Point, and $1\frac{1}{2}$ miles from the sea.	Common argand	White, 126 feet...
71	Pilot's Ridge (light-vessel)	On Pilot's Ridge, during the S.-W. monsoon only, in 22 fathoms water.	C. D.	White, 48 feet...
72	River Hooghly. { Eastern Channel (light-vessel).	Entrance to Eastern Channel, in $10\frac{1}{2}$ fathoms water.	C. D.	White, 48 feet...

## the coasts of British India—continued.

## MADRAS PRESIDENCY—concluded.

Fixed, flashing, intermitting, alternating or revolving.	Miles visible in clear weather.	Nature of construction, colour, or any peculiarity of light-house.	Height, in feet, of building from base to vane.	REMARKS.
F.	10	Masonry column. White ...	57	When the light bears W. $\frac{1}{2}$ N., a vessel is to the northward of all dangers of the Pulicat Shoal.
F.	14	Masonry column. White ...	111	Warns vessels off the Arnegon Shoals, the shoalest part of which ( $1\frac{1}{2}$ fathoms) lies 6 miles off shore.
<i>Revolving Holophotal.</i>	14	<i>Masonry column</i> ...	55	<i>To mark the rising port of Kuttowpatam, off which there is a mud bank like Naraket. Also to clear the Mootapilly Shoals.</i>
F.	14	Masonry column. White ...	57	
F.	6	Flagstaff ...	112	Is a harbour light, and was originally red, but being only a 6th order light, it was altered, as a temporary measure, to a white light, by the removal of the coloured media.
<i>Fixed.</i>	7	<i>On the present beacon</i> ...	.....	<i>To mark Narsapore Point.</i>
F.	12 to 15	Masonry tower. Horizontal alternate bands of black and white.	94	Intended to lead vessels clear of the rocks and shoals off Godavery Point; but being considered unsuitable in every way, a proposal for a new light is under consideration.
Rev. 20 seconds.	14	White column ...	76	This light is intended to lead vessels clear of the shoals to the northward of Point Godavery, when coming into the Cocanada anchorage from the southward and eastward.
.....	.....	.....	.....	A red light was formerly exhibited from the Dolphin's Nose, but was destroyed during the cyclone of October 1876, and has not since been replaced.
F.	14	On the roof of a house ...	31	Exhibited to warn mariners off the Santipilly Rocks, from which this light bears N.-W. $\frac{1}{2}$ W., distant $6\frac{1}{2}$ miles.
F.	8	Obelisk of cut stone. Column, white; capital, dark-blue.	73	Intended to warn vessels off a small reef which projects from the point, and which should not be passed in less than 8 fathoms when making the port at night.
F.	12	Flagstaff, painted white ...	.....	Only a port light.

## BENGAL PRESIDENCY.

F.	About 2	On the eastern yard arm of a flagstaff.	.....	
F.	16	Reddish granite, with a large white star in the centre.	129	A first order dioptric apparatus is shortly to be fitted here. The light is to be visible about 20 miles, through an arc of $200^{\circ}$ . It is <i>proposed</i> to exhibit a small harbour light on the tip of Reddie Point.
F.	12	Floating light-vessel, painted buff, during the day flies a station flag at the lantern mast-head.	.....	Exhibited during the south-west monsoon only (15th March to 15th September). A blue light is burnt every hour, commencing at 7 P. M., and a maroon at the intermediate half hours.
				As a distinguishing mark, by day, this light-vessel will carry at her mast-head a ball painted white, with black horizontal band round its centre.
				Is intended as a guide to vessels making the Hooghly Pilot station during the south-west monsoon; also as a mark for the Pilot vessels cruising.
F.	12	Floating light-vessel, painted buff, during the day carries a large black ball at her lantern mast-head.	.....	During the south-west monsoon (15th March to 31st October) a blue light is burnt every half hour, and a maroon at the intermediate quarters of an hour.
				In the north-east monsoon (31st October to 15th March) a blue light every hour and a maroon at the intermediate half hours, commencing at 7 P. M.

## List of Light-houses and Light-ships around

## INDIA, EAST COAST—

No.	Name of light.	Location.	Character and order of illuminating apparatus.	Colour of light and height above Sea.
73	Intermediate (light-vessel).	Entrance to Channel, in $6\frac{1}{2}$ fathoms, between the Eastern Channel and Lower Gasper light-vessels. Lower Gasper light-vessel bearing N. by W. $\frac{1}{2}$ W., 12 miles.	C. D.	White, 48 feet...
74	Lower Gasper (light-vessel).	Lower Gasper Channel, in 25 feet water ...	C. D.	White, 48 feet...
75	Upper Gasper (light-vessel).	Gasper Channel, in 21 feet water ...	C. D.	White, 24 feet...
76	Saugor ...	Middleton Pt., S.-W. end of Saugor Island, about 200 yards from low water mark.	Common argand	White, 74 feet...
77	Cowcolly ...	2 miles S. W. of Kedgeree Point ...	Common argand	White, 62 feet...
78	Mutlah light-vessel ...	Entrance to River, in 11 fathoms ...	C. D.	White, 48 feet...
79	Sundeep ... Chittagong ...	On the mainland opposite Sundeep ... $1\frac{1}{2}$ miles south of Norman Pt., southern shore, entrance to Kurnafoolee River.	D. 5th Ord. A light-ship's lantern in each.	White, 45 feet... 2 White, inner 37 feet, outer 32 feet.
80	Kutubdea ...	West part of the island ...	An 8-reflector lantern.	White, 126 feet...

## BRITISH

81	Naaf River ... Oyster Reef ...	South edge of reef, in 4 fathoms at low-water spring tides.	D. 5th Ord. D. 2nd Ord.	White, with red cut White, 77 feet...
82	Savage Island ...	On island, entrance to Akyab harbour ...	D. 3rd Ord.	White, 99 feet...
83	Terribles ...	On South Terrible ...	.....	.....
84	Alguada ...	On the reef, which lies south of Bassein River, 11 miles from Diamond Island.	C. D. 1st Ord.	White, 144 feet...
85	Krishna (light-vessel) ...	In $4\frac{1}{2}$ fathoms, eastern side of Krishna Shoal...	C. D.	White, 48 feet...
86	Great Coco Group, Andaman Islands.	On S. W. end of Table Island, 2 miles from Great Coco Island.	D. 1st Ord.	White, 195 feet...
87	China Ba-Keer ...	In 2 fathoms at low-water spring tides. On the edge of the flats extending off the entrance to the China Ba-Keer or Ton-Kwa River.	D. 1st Ord.	White, 78 feet...
88	Eastern Grove (Rangoon) River. Amherst (Moulmein) ...	Close to high-water mark on Grove Point east side of entrance to river. By the pilot's flagstaff ...	D. 3rd Ord. D. 5th Ord. signal light.	White, 93 feet... Red, 40 feet ...
89	Double Island ...	On the Island ...	D. 1st Ord. with a C. D. mirror.	White, 164 feet...

## the Coasts of British India—continued.

## BENGAL PRESIDENCY—concluded.

Fixed, flashing, intermitting, alternating or revolving.	Miles visible in clear weather.	Nature of construction, colour, or any peculiarity of light-house.	Height, in feet, of building from base to vane.	REMARKS.
F.	10	Floating light-vessel, <i>Intermediate</i> , wooden, painted buff.	.....	Will be placed in position from the 1st April to the 31st of October. By day will exhibit a large black double triangle at lantern mast-head, and by night a riding light on the forestay, 6 feet above the rail.
F.	12	Floating light-vessel, painted buff.	.....	Burns a blue light at the half hour and a maroon at the hour all the year round. During fogs, signal guns will be fired at the hour and half hour.
F.	9	Floating light-vessel, painted buff.	.....	The lantern is hoisted only half mast high. During fogs, signal guns will be fired at the first and third quarters of the hour.
F. Fl. Irregular.	15	Iron. Red and white alternate bands.	76½	Electric telegraph to Calcutta.
F.	12 to 14	Brick. White ...	88	Intended to lead vessels through Lloyd's Channel, and clear of the sand to the southward.
F.	12	Floating light vessel, painted red, and during the day flies a station flag at her lantern mast-head.	.....	If in her position, fires a rocket at 8 P. M., midnight, and at 4 A. M. During the day, as a distinguishing mark, this light-vessel will carry at her mast-head a ball painted red, with a white horizontal band round the centre.
Fixed	10	Stone or timber ...	45	The light is intended as a guide to the Hooghly for vessels coming from the eastward.
F.	7	Inner or eastern light on wooden tripod painted black; outer or western light on a mast painted red.	.....	To guide vessels into shelter behind Sundeeep. The best anchorage for a vessel inward bound is with the beacon lights in line, and flagstaff hill bearing N.-E., in 5 fathoms, soft mud.
F.	18	Masonry ...	108	Intended for local purposes.

## BURMA, &amp;c.

Fixed	10	.....	.....	To guide into river.
F.	15	Iron screw piles. Red, with white lantern.	.....	To mark the reef on which it stands, and to render safe the western and northern approaches to Akyab harbour.
F. Fl. every minute.	14	Sandstone masonry tower. Round, with red lantern.	50	To facilitate entering Akyab harbour.
.....	.....	.....	.....	Proposed.
Rev. every minute.	20	Granite masonry. Alternate black and white bands, 18 feet wide, black at base.	160	To keep vessels clear of the Alguada Reef. Vessels should not shoal to less than 15 or 20 fathoms.
F.	10	Floating light-vessel, painted yellow.	.....	The Krishna screw pile light-house was destroyed in August 1877. The light-vessel shows a blue light every half hour, which is visible 20 miles, and a maroon at the intermediate quarter hours commencing at 7 P. M. During the day, a red flag is shown from the lantern mast-head.
F.	22	Cast-iron tower. Circular, with alternate red and white bands.	91	To facilitate the navigation of Preparis Channel.
F. Fl. every minute.	15	Iron screw piles. Red, with white lantern.	.....	Landfall light for Rangoon River.
F.	12	Iron screw piles. Red, with white lantern.	102*	Denoting the navigable channel into the port of Rangoon.
Fixed.	4	Small masonry column ...	10	To denote anchorage and mark entrance of Moulmein river.
F.	19	Masonry tower ...	75	Is a guide to vessels making for the port of Moulmein.

## APPENDIX B.

## TIDAL OBSERVATIONS IN INDIA.

Dated Calcutta, 15th July 1879.

## DEPARTMENTAL ORDER.

*To—The Deputy and Assistant Superintendents in charge of Coast Surveys.*

1. In order that there shall in future be no ambiguity in the expression "Low water ordinary spring tides," as used on the charts and in the Hydrographic Notices and other publications issued by this Office, the following definitions and instructions are circulated for the information and guidance of the officers of the department.

2. The necessity for thus exactly defining the value of the datum to which the soundings are reduced (low water ordinary spring tides) is now the more important, as Captain Baird, R. E., who is conducting the tidal registrations round the coast of India, will, as the observations are completed, compile tide-tables for the ports at which his gauges have been at work. It is therefore most desirable that these computations should be referrible in every case to the zeros or datum lines to which the soundings on the Indian charts published by this Department are reduced.

3. For this purpose "*ordinary spring tides*" are to be considered as those which occur when the moon is not in perigee within 36 hours of new or full moon.

4. Bearing in mind the above definition of "*ordinary spring tides*," the term "*Low water ordinary spring tides*" is therefore to be understood as representing the mean value of the heights of the lowest tides of each semilunation (A. M. or P. M., as the case may be), and each of which occurs from 24 to 36 hours after both full and change. This mean will be deduced from the observations made during the progress of the survey, and the height (as shewn on the gauge) thus determined on—and which will, for purposes of reduction of soundings, be termed the "Zero"—is then to be referred to a pukka bench mark by carefully measuring the difference of height by means of the spirit-level.

5. All soundings are to be reduced to the level of *low water ordinary spring tides* as above defined.

6. The value, termed the datum, referred to a bench mark as above directed, and assumed as the level of low water at ordinary spring tides, is in every case to be noted on the chart, as in the following example:—

"The soundings are reduced to low water ordinary spring tides, *vis.*, 21,435 feet below the datum mark (  $\nabla$  ) cut in the wall (near the Sally Port) on the east side of Viziadurg Fort."

7. No chart will be considered complete, nor will it be received into office, unless the datum line has thus been fixed and recorded on the original drawing. When a survey is intended of any locality where one of the Government gauges is at work, the officer in charge should apply to Captain Baird, R. E., (at the Office of Tidal and Levelling Party, Poona), for the value of "*Low water ordinary spring tides*" as referred to one or more of his bench marks, and the soundings are then to be reduced to *that* datum.

8. When, however, the surveys precede the exact determination by Captain Baird of the value of low water spring tides, the before-mentioned approximate value (deduced as explained in paragraph 4), and referred to a bench mark of the description given hereafter, is to be adopted. This mark will afterwards be connected by levelling, by Captain Baird, with his more substantially-constructed bench marks.

9. Captain Baird will be supplied with copies of the surveys executed by the officers of this Department immediately they are published, in order that he may be able to note in each locality the value of the datum adopted by the Surveyors.

10. The bench marks put up by officers of this Department should be a mark in the usual form (  $\nabla$  ), the horizontal line above the broad arrow being the line of reference. The letters B M should also be placed underneath the mark, and all should be cut deeply in the stone-facing or plinth of the nearest substantial building in the vicinity of the tide gauge.

## APPENDIX C.

*Memorandum on Indian Tides by Commander A. DUNDAS TAYLOR, I.N., F.R.G.S.,  
Superintendent, of Marine Survey of India.*

The few remarks upon the tides of the Indian Ocean, in the introductory portion of my "Sailing Directory," do not sufficiently explain the peculiarities of our tides, which all surveyors, pilots, and navigators in general cannot fail to notice. It occurs to me, therefore, that the following remarks, accompanied by a diagram\* and tables, may be found helpful.

2. The subject of Indian tides was first thoroughly taken in hand† by Mr. William Parkes, C.E., when engaged upon the harbour works of Kurrachee, and for the last ten years most useful tide tables have been annually prepared by him for that port, as also for Bombay. Mr. Parkes indicated the following cases in which great benefit would be derived from a more correct foreknowledge of tidal movements:— "The docking and undocking of large ships; the hauling up, launching and repairing, of small ones; the floating off of stranded vessels; the navigation of the creeks and shallow parts of a harbour; the working of lighters, barges, and other small craft by the assistance of the tidal currents; and in the case of Kurrachee, the still more important point of access to the harbour itself."

3. In 1868 the Government of India directed Colonel Walker, Superintendent, Great Trigonometrical Survey, to take steps for investigating the question whether changes were taking place in the relative levels of the land and sea at certain points on the Indian coasts, more particularly in the Gulf of Kutch and on the coasts of Kattywar. For this purpose a complete series of tidal observations was made by Captain Baird, R.E., with self-registering gauges at three places in the Gulf of Kutch. The results, showing the great diurnal inequality in the heights of both high and low water, were deemed so valuable as to call for similar registrations all around the British Indian coasts, both for scientific and nautical purposes, and Captain Baird was in 1877 appointed Superintendent of Tidal Observations in India.

4. It happens that the diurnal inequality on the coast of England is so small as to have been considered a comparatively unimportant matter; but Sir William Thompson has pointed out, "if a vessel happened to get on a rock, it was a serious question whether the morning tide might be considered to be higher than the night tide. Nobody on the East Coast (England) could tell at any particular time of the year whether the night or day tide was the higher. It was said the morning tides were higher than the night tides, but that was simple nonsense, although at certain periods such was the case." It thus appears that scientific men are not satisfied with the amount of attention bestowed upon tidal investigation on English coasts. The Admiralty Tide Tables only predict the time and the *mean* height of the high waters, whilst the zero of the tables is given as the *mean* height of the low water of ordinary spring tides. Parkes' diagram for Kurrachee makes it very clear that the Admiralty method will not suffice for our intertropical tides, because it ignores the diurnal inequality.

5. The diurnal inequality.—Although this term may be applied to both the times and the heights of high water along our coasts, yet its application has more immediate reference to the heights, because the *amount* of rise or fall in feet is the important question to the pilot. The diurnal inequality has been explained as the difference in the alternate superior and inferior high waters; the superior high water meaning that which occurs when the moon is above the horizon, and the inferior high water when she is below. But there is likewise a more marked diurnal inequality in alternate low waters; and, as the difference sometimes amounts to nearly *one-half the extreme range* of the spring tides, the importance of knowing this and of having tide tables which recognise these inequalities of both high and low waters cannot be exaggerated.

6. In the Gulf of Cambay there is a diurnal inequality of 7 or 8 feet in the height, but the two tides arrive at their regular intervals; there seems to be not much inequality of time. At Kurrachee (see Table B) the inequality in consecutive evening and morning low waters, at some spring tides, amounts to 5 feet where the greatest range is 11 feet. In the face of facts like these, it behoves us to be very explicit in the tidal remarks appended to our charts.

7. The Plane of Reference.—The time seems opportune to lay down certain definite rules regarding the datum level or plane of reference to which the soundings on our Indian charts should be reduced. But it is as well that we should give a few preliminary remarks as to the practice followed by the British Admiralty and the United States Coast Survey. The plane of reference adopted by the latter is stated in Jeffers' Nautical Surveying (published at New York) to be as follows: "The depths, as now represented upon the charts of our Coast Survey, are referred to mean low water." Further on, the author says: "Before placing the soundings on the charts, it is necessary to reduce them, that the chart may show only such depth of water as will be found on those points at the lowest ebb or mean low water, whichever may be selected as the plane of reference."

8. Now the lowest ebb and the mean low water have very different values at both Bombay and Kurrachee, and indeed all around the Coast of India. In proof of this, let us examine

\* This diagram is not in this report as it could not be re-published.

† The United States Coast Survey Department published in 1868 a most valuable scientific paper on Tides and Tidal Phenomena, which explains many peculiarities of the semidiurnal (*lunar*) and the diurnal (*solar*) tides, as well as those of the mixed type.

Tables A and B, selecting the solstitial tides of June and December : in the latter month the afternoon tide is lowest, in the former month the morning tide is lowest :—

	Ft.	In.	
June 15, full moon gives morning low tide	0	9	below datum.
Ditto ditto afternoon do.	4	4	above "
The mean low water of the springs is therefore	1	9½	" "
The lowest ebb which occurs in the morning is	0	9	below "
December 9, full moon gives morning low tide	4	9	above "
Ditto ditto afternoon do.	0	1	" "

The mean low water of the springs is here 2 feet 5 inches above datum, whilst the lowest ebb of the afternoon stands only one inch above.

9. Mean low water can only be taken to signify the mean of all low waters throughout the year. Now to obtain this value, in the typical case of Kurrachee, I search through Parkes' Tide Tables for 1878, and find that it is 2 feet 5½ inches above datum :

Pt.	In.	6-0	5-0	5-5	5-1	6-3	6-7	5-0	3-1	4-2	6-9	5-8	6-7	66-3	5-5
		2	2	2	2	2	2	2	2	2	2	2	2	12	2
Month.		January	February	March	April	May	June	July	August	September	October	November	December		Mean

The mean low water of full moon spring tides in December appears to have the same value as the mean low water throughout the year ; but that of June differs 8 inches. However, the greatest difference between the lowest ebb and mean low water at Kurrachee will be found by the tables to amount at times to 4 feet.

10. At another page of the same book (Jeffers on Nautical Surveying) the following statement is made : " It is, however, sufficient for nautical purposes to reduce the soundings to the lowest of the low waters observed, unless this is evidently due to some abnormal cause." I believe all the Indian Navy Surveyors adopted this plan. I inherited it from Montriau, who had served under Daniel Ross and Lloyd. Most of the old Indian charts had the *lower* low water (whether morning or afternoon) of ordinary spring tides as the plane of reference.

11. Whilst surveying the west coast of India between 1853 and 1859, it became apparent that, owing to the inequality in height of the morning and evening low tides of the same day, I must needs append a remark on the charts in explanation of the datum level to which the soundings were reduced. On the original chart of Karwar or Sedashigar Bay the following notice was given : " The soundings are reduced to the evening low water of spring tides between October and March, which is nearly the same as the morning low spring tide between March and September. The low waters of neap tides and morning low waters of spring tides between the first-named months are about the same level, giving three feet more water than shewn on this chart ; and the same applies to the evening low water, between March and September. High water occurs at full and change of the moon at about X hours, and gives 6 feet more water in the day time and 7½ feet at night than herein shewn between October and March, but the contrary is the case during the rest of the year." For some unknown reason these remarks have been expunged from later editions of the Admiralty Chart of Sedashigar Bay ; but, for the want of some such notice, and in the absence of any tide tables for this port, the chart as now published is defective. The extreme range of tide at Karwar is now found to be 10 feet ; at Kurrachee it is 11 feet. Reference to the Kurrachee Tide Tables will show that some such remark might with advantage be likewise appended to the chart of that place.

12. Passing now from American and Indian methods of reduction to that of the British Admiralty, we find that the General Instructions (revised in the year 1877) for their Hydrographic Surveyors give quite another plane of reference. There we find " soundings are reduced to mean low water of ordinary spring tides." " The rise of tide is measured from the mean low water level of ordinary springs." " All soundings should be made by one uniform system to represent in *all* charts the depths reduced to the low water level of ordinary spring tides."

13. A glance at the diagram will show that the diurnal inequality must be absolutely ignored if we take the mean low water of spring tides as our datum level. Let us also examine the Kurrachee Tide Tables for the purpose of elucidating this momentous question. The mean low water level of the day following both new and full moons is worked out in Table A, as 1 foot 6½ inches ; but there we have included all spring tides, ordinary and extraordinary ; if half a dozen of the extraordinary are rejected in summing up, the mean low water level of ordinary spring tides would stand higher or 1 foot 8½ inches above datum. But Mr. Parkes states that his datum level is the same as that to which the soundings on the Admiralty Charts



are referred. Clearly, then, the Admiralty instructions have not been carried out at Kurrachee ; indeed, an inspection of Table B shows that the plane of reference at that port may be taken as about the mean lower tide level of all spring tides throughout the year.

14. It will be obvious from the foregoing remarks that we must have one definite datum value on all our Indian Charts. The plane of reference must not be left to the choice of each individual surveyor, but there must be a fixed rule ; so that the Superintendent of Tidal Observations, in framing tide tables for ports where his registrations have preceded the hydrographic survey of the place, may know beforehand what datum level the Marine Survey Department intends to adopt. On the other hand, we must carry out the practice of leaving certain well-defined bench marks at all places where the Marine Survey operations precede the establishment of Captain Baird's self-registering tide gauges. Instructions for dealing with the registration of tidal observations and the reduction of soundings on Indian charts, will soon be published.

TABLE A.—To illustrate the "Mean Low Water Level of all Spring Tides" at Kurrachee.

Month.	Moon's Phases.	Hor. Par.	Next Morning Low Tide.	Next After-noon Low Tide.	Mean L. W. Level.	Extreme Range of Tide.
			ft. in.	ft. in.	ft. in.	ft. in.
Jan....	3rd New 8th Apo.	54 6	4 3	0 3	2 3	New Moon Tide 8 10
	19th Full 20th Per.	60 46	2 10	0 4B	1 3	Full and Perigee 10 8
Feb....	2nd New 5th Apo.	53 59	3 2	1 2	2 2	New ... 7 8
	17th Full 18th Per.	61 20	1 7	0 4	0 11½	Full and Perigee 10 0
March	4th New 4th Apo.	53 55	1 11	1 11	1 11	New ... 7 0
	19th Full 18th Per.	61 25	0 6B	1 9	0 7½	Full ... 10 9
April	3rd New 31st Apo.	53 57	0 9	3 1	1 11	New ... 7 10
	17th Full 15th Per.	60 56	1 3B	2 11	0 10	Full ... 11 0
May	2nd New 28th Apo.	54 4	0 2	3 11	2 0½	New ... 8 6
	16th Full 13th Per.	60 9	1 4B	3 10	1 3	Full ... 10 10
June	1st New 25th Apo.	54 12	0 5B	4 6	2 0½	New ... 9 3
	15th Full 10th Per.	59 25	0 6B	4 0	1 9	Full ... 10 0
	30th New 22nd Apo.	54 15	0 7B	4 0	1 8½	New ... 9 6
July...	14th Full 5th Per.	59 30	0 3	3 6	1 10½	Full ... 9 0
	30th New 20th Apo.	54 11	0 1B	2 1	1 0	New ... 10 0
Aug.	13th Full 1st Per.	60 17	1 1	2 5	1 9	Full ... 8 3
	17th Apo.	54 4				
	28th New 29th Per.	61 1	0 7	0 7	0 7	New and Perigee 10 9
Sep....	11th Full 13th Apo.	53 57	1 10	1 8	1 9	Full ... 7 0
	26th New 26th Per.	61 24	1 6	0 6B	0 6	New and Perigee 10 10
Oct....	11th Full 10th Apo.	53 57	3 1	0 8	1 10½	Full ... 7 10
	26th New 25th Per.	61 16	3 3	1 6B	0 10½	New and Perigee 11 0
	6th Apo.	54 1	4 2	0 2	2 2	Full ... 8 6
Nov.	10th Full 22nd Per.	60 39	3 11	1 6B	1 2½	New and Perigee 11 3
	24th New 4th Apo.	54 7	4 5	0 1B	2 2	Full ... 9 0
Dec....	10th Full 20th Per.	59 43	3 9	0 4B	1 8½	New ... 10 8
	24th New 31st Apo.	54 12				
					25 38 2	
"Mean Low Water Level of Spring Tides," or, Mean of Means = 1 6½ above datum.						

The above tidal values are taken from the official Kurrachee Tide Tables for 1878, prepared by Mr. W. Parkes, C. E., who explains that "the Datum Level is the same as that to which the soundings on the Admiralty Charts are referred. Tides which fall below datum are distinguished by the letter B."

It will be seen that on the day following the new moon of November, which is nearly coincident with the moon's Perigee, the diurnal inequality of the morning and afternoon low tides actually amounted to 5 feet 5 inches, which is very nearly one-half of the extreme range of tide at Kurrachee.



APPENDIX D.

CHARTS—MADRAS.

*Memorandum by Mr. R. C. Carrington, Superintendent, Compiling and Drawing Branch, on the charts forwarded to this Department from Madras for examination,—dated 14th May 1879.*

When the Superintendent of Marine Surveys was in Madras in March 1878, he discovered that a very large number of old and obsolete charts had been stored there for many years past. It was at first contemplated having these sheets examined at Madras, but, after discussion, this was considered unnecessary, and eventually they were forwarded to this Department, and have now been examined.

Nearly all the charts were useless, being old editions of Admiralty or East India Company sheets, many uncorrected since first issued, some twenty to seventy years ago. These charts would, of course, be misleading and dangerous to issue, and have therefore been destroyed. A large number were ragged, damp-stained, or eaten by worms and cockroaches.

A few sheets have been kept for reference. Especially useful are the physical charts of the Indian and Chinese Seas and the Gulf of Persia; these will be stored in the Department. Other sheets, such as the approaches to Rangoon and Chittagong rivers, Cochin harbour, &c., shewing the surveys executed thirty or forty years ago, will be useful for the purpose of comparing the hydrographic changes that have taken place.

None of the charts that have been preserved can, however, be issued to the public, and are of little or no value to any one outside this office.

The whole stock has been carefully gone through, and remarks have been made in the tabulated statement which will explain why the various sheets were cancelled.

The following shews the result of the examination :—

Useful copies kept for reference	433
Charts cancelled and destroyed	4,419
Total number examined.	4,852

CHARTS—MADRAS.

Title of Chart.	Copies.	REMARKS.
Straits of Sunda	12	Cancelled by the chart of Sunda Straits published at the Admiralty. These sheets were issued 65 years ago.
East coast of Sumatra from Diamond Point to the southern entrance of Brewer's Straits	18	Cancelled by the charts issued at the Admiralty.
Island of Socotra	17	Cancelled. Longitudes in error; no compasses; sheets old.
Reef and Point of Palmyras	18	Twelve cancelled, six kept for reference.
Bushire to Bassadore (Persian Gulf)	18	Cancelled by the Admiralty charts.
Islands and channels at the south-west extremity of the China Sea	23	Cancelled by the new charts issued by the Admiralty.
Principal harbours and anchorages in the Red Sea	18	Cancelled by the new edition issued at the Admiralty; sheets untouched for 40 years.
Coast of Cochin China	18	Cancelled by the new French surveys and issued by the Admiralty.
Red Sea (from Jeddah to Bab-el-Mandeb)	16	Cancelled by the new charts issued at the Admiralty.
Western group of the Paracels	18	Cancelled by Admiralty chart. Sheets untouched for 70 years.
Western coast of Sumatra	11	Cancelled. All wrong. Superseded by Admiralty modern chart.
Samangca Bay	18	Cancelled by modern charts. This was published in 1818. Sheets old and useless.

Title of Chart.	Copies.	REMARKS.
Persian Gulf . . . . .	18	Cancelled. Old edition superseded by Constable's and Stiffe's surveys.
Northern Pepper Ports, west coast of Sumatra . . . . .	17	Cancelled. Sketch plans published 68 years ago. Useless.
Mutlah River . . . . .	41	Cancelled by the new editions issued since 1855.
Rangoon River . . . . .	15	Cancelled by new survey by Jarrad. This is Ward's survey of 1954. Two copies kept for reference.
Mergui Harbour . . . . .	17	Cancelled by the Admiralty chart of the harbour.
Persian Gulf: Entrances to the rivers at the head of the—	19	Cancelled by the Admiralty charts.
Red Sea, comprising the parts above Jeddah . . . . .	15	Cancelled by the new editions issued by the Admiralty.
Sea-face of the Sunderbuns . . . . .	17	Ditto ditto.
Maldiv Islands . . . . .	17	Kept; good.
Ditto (small scale) . . . . .	15	Ditto.
Gulf of Pechili . . . . .	17	Cancelled by the chart issued by the Admiralty.
Entrance to the Persian Gulf . . . . .	32	Cancelled by the new editions issued by the Admiralty. Charts eaten by cockroaches.
Swan River and Rottnest Island . . . . .	29	Cancelled. Long since superseded by the Admiralty new charts.
Entrance to the Red Sea . . . . .	18	Cancelled by new charts issued by the Admiralty.
Coast of Persia (from Kooe Mubarrack to Krotchey) . . . . .	18	Cancelled by the edition of the sheet issued by the Admiralty.
Red Sea (from Jeddah to Bab-el-Mandeb)	17	Cancelled by new charts issued at the Admiralty.
Sarawak River . . . . .	3	Cancelled by the Admiralty chart of the river.
Part of the Mergui Archipelago, two sheets . . . . .	33	Cancelled. The same sheet is now issued by the Admiralty, but corrected.
Harbours of Muttra and Maskat . . . . .	18	Cancelled by Admiralty new charts.
Mathurin Bay . . . . .	16	Cancelled. Outline charts; sheets worn out, 60 years old.
Moulmein River and the east coast of Martaban Gulf . . . . .	13	Cancelled by new surveys by Jarrad. This is Fell's survey of 1847. Two copies kept for reference.
Namo Harbour . . . . .	17	Cancelled. Charts useless, 71 years old.
Part of the Arabian side of the Persian Gulf . . . . .	18	Cancelled by Admiralty new charts.
Channel to the westward of the Romania Reef . . . . .	18	Cancelled. Old charts published 60 years ago. Useless.
Maldiv Islands . . . . .	15	Kept; good.
North and South Sands in the Straits of Malacca . . . . .	17	Cancelled by the new edition published by the Admiralty.
Paumben Pass . . . . .	39	Cancelled by Admiralty charts and new surveys by M. Chapman in 1878.
Penang, or Prince of Wales' Island . . . . .	22	Cancelled by the Admiralty chart of Penang. Sheets uncorrected for 38 years.
Mauritius, or Isle of France . . . . .	19	Cancelled by the Admiralty new edition.
Clarence's Strait (Gulf of Persia) . . . . .	2	Cancelled. Charts old and worn out.
Winds and currents in the Persian Gulf (for every month in the year), twenty-five sets . . . . .	300	Cancelled. Six complete sets kept for reference.
Malacca Banks . . . . .	18	Cancelled by the new editions issued by the Admiralty.
Maldiv Islands . . . . .	15	Kept; good.
Macassar . . . . .	18	Cancelled by modern Admiralty sheets. An outline sketch published in 1816.
Rangoon River . . . . .	15	Cancelled by the new surveys by Jarrad and Pearson. This shows the survey by Ross in 1825. Two copies kept for reference.

Title of Chart.	Copies.	REMARKS.
Gage Road and Swan River . . . . .	3	Cancelled. Sheets torn and useless.
Red Sea . . . . .	15	Cancelled by the new charts issued by the Admiralty
Ratnagiri . . . . .	17	Cancelled by the new surveys. Six kept for reference.
Harbours and anchorages in the Red Sea .	18	Cancelled by the new editions issued at the Admiralty.
Tracks of "Discovery" and "Antelope" shewing the situation of the Paracels .	18	Cancelled. Useless. Charts untouched for 70 years.
Coast of Persia (from Ras Tuloop to Bushire) . . . . .	18	Cancelled. Longitudes, compasses, &c., all wrong. Charts untouched for 50 years.
East coast of the Malay Peninsula . . . . .	18	Cancelled by modern charts. Useless.
Pulo Leat or Middle Island, with the exact situation of the Coral Reef . . . . .	18	Cancelled. East India Company's sketch chart published in 1819.
The entrance to the Gulf of Persia and coast of Arabia . . . . .	18	Cancelled by Constable's and Stiffe's surveys.
Sea-face of Sunderbuns . . . . .	36	Cancelled by the various editions issued by the Admiralty since 1842.
Suez Harbour . . . . .	43	Cancelled by the new surveys and charts published by the Admiralty.
Rajapur River . . . . .	17	Cancelled by the Admiralty edition of the same sheet.
Swan River . . . . .	9	Cancelled by modern charts.
Narrakel Anchorage . . . . .	17	Cancelled by chart of the roadstead issued by this Department.
Raja Bassa Road . . . . .	18	Cancelled. Sheets 64 years old. Sketch plan.
Sunderduns (Sheets A and B). . . . .	23	} Cancelled by the various editions issued by the Admiralty since 1840.
Ditto (Sheet C) . . . . .	23	
Singapore Harbour . . . . .	18	Cancelled by Admiralty chart of the harbour.
Sunda Straits . . . . .	18	Cancelled by Admiralty chart of the Straits. Sheets 58 years old.
Preparis North Channel . . . . .	38	Cancelled. Lithographed charts superseded by Admiralty edition of the sheet.
Sirangoon Harbour and Jahore Channel .	7	Cancelled. Admiralty edition of 1846. Useless.
Penang Island and Harbour . . . . .	23	Cancelled by the Admiralty chart of Penang.
Ratnagiri . . . . .	34	Cancelled by new surveys. Charts eaten by cockroaches.
Singapore Harbour . . . . .	13	Cancelled by the new chart of Singapore. Sheets eaten by cockroaches.
Rajapur River . . . . .	35	Cancelled by the Admiralty edition of the sheet. Charts old and eaten by cockroaches.
Macao Roads . . . . .	19	Cancelled by Admiralty chart of the roads.
Mootapilly Bay . . . . .	17	Cancelled by Admiralty sheets. Sheets untouched for 40 years.
Oie-hai-Oie Harbour . . . . .	18	Cancelled by Bullock's survey. These sheets were 60 years old.
Sonmeeanie Harbour . . . . .	41	Cancelled by the edition issued by the Admiralty.
Natuna Islands . . . . .	18	Cancelled by the Admiralty chart of the islands. These sheets are 40 years old.
Palks' Strait . . . . .	42	Cancelled by the Admiralty chart. Longitudes in error and compasses wrong.
Croce Roads (west coast of Sumatra) . .	18	Cancelled by modern charts. Sheets 70 years old.
West coast of India . . . . .	10	Cancelled by later editions of Admiralty charts. These sheets were uncorrected for 20 years.
Lakadive Group . . . . .	26	Cancelled. Old and worn out.
Kattywar Coast . . . . .	17	Cancelled. Horsburgh's outline chart, superseded by our new photozincographed sheets.
Kyonk Phyou Harbour . . . . .	18	Cancelled. Ross' survey, 1832. Corrected sheet issued by the Admiralty.
Bushire Roads . . . . .	17	Cancelled by modern Admiralty charts. These sheets were rotten, not touched for 50 years.
China Sea (Sheet 1) . . . . .	20	Cancelled. Long since superseded by the Admiralty charts. This edition is dated 1821.
Harbour of Hui-Ling-Shan . . . . .	18	Cancelled by Admiralty charts. Sheets worn out.

Title of Chart.	Copies.	REMARKS.
Clarence's Straits (Gulf of Persia) . . .	19	Cancelled. Sheets in good condition, but fathom lines and magnetic variations, &c., all wrong. Sheet uncorrected for 50 years.
Channel from Linton to Boca Tigris . . .	17	Cancelled. Charts worn out.
China, East Coast . . . . .	18	Cancelled. Long since superseded by Admiralty charts (uncorrected for 31 years).
Chittagong to Arracan River . . . . .	17	Cancelled by Admiralty sheet. The details of the coast entirely wrong.
Arabian Sea and Indian Ocean . . . . .	16	Cancelled. Coast line all wrong. Sheets 62 years old.
Coast of Ava . . . . .	17	Cancelled. The approaches to Bassein River all wrong. Sheets 52 years old.
Coringa or Cocanada Bay . . . . .	16	Cancelled by modern surveys. Six copies kept for reference.
Gulf of Kutch . . . . .	18	Cancelled. Middleton's outline survey published in 1823. Sheets torn and worn out.
Portion of Gaspar Straits . . . . .	18	Cancelled. All wrong in detail. Sheet published merely for the purpose of shewing two or three tracks of vessels through.
Deoghur Harbour . . . . .	27	Cancelled. This is the same sheet as now issued by the Admiralty (uncorrected for 30 years).
Hastings Harbour . . . . .	25	Cancelled. Sheets worn out, 50 years old.
Gulf of Cambay . . . . .	18	Cancelled. Same sheet as now issued by the Admiralty. (Uncorrected for 34 years.)
River Hooghly (Calcutta to Sangor Point)	32	Cancelled by modern editions. Sheets uncorrected for 42 years.
South-east coast of Arabia . . . . .	17	Cancelled. Now issued by the Admiralty in a revised form.
Andaman Islands . . . . .	28	Cancelled. Southern sheet of Lieutenant Blair's survey. Copies in office. Sheets very dilapidated.
Coast of Africa . . . . .	17	Cancelled long since by new editions issued at the Admiralty.
Arracan River . . . . .	45	Cancelled. This is an outline chart published in 1832. Cancelled by Admiralty sheet.
Coast of China (Sheet 2) . . . . .	20	Cancelled long since by new charts issued at the Admiralty.
Coast of Palawan . . . . .	18	Cancelled by Bate's surveys. Sheets worn out.
Island and Harbour of Bahrein . . . . .	18	Cancelled by Admiralty charts and our surveys.
Hooghly Sands and Channels . . . . .	8	Cancelled by modern Surveys sheets 37 years old.
Carimata Passage . . . . .	18	Cancelled by modern Admiralty charts. Sheets 58 years old.
Demerara River . . . . .	16	Cancelled by new surveys and charts issued by the Admiralty.
China Sea (Sheet 1) . . . . .	2	Cancelled. Worm-eaten.
Great Andaman . . . . .	14	Cancelled. Dalrymple's charts. Copies in Office.
Caloombyan Harbour . . . . .	18	Cancelled. Sheets obsolete, issued 60 years ago.
Canton River (Sheet 3) . . . . .	5	Cancelled by the new editions published by the Admiralty. Sheets torn.
Straits of Bally . . . . .	17	Cancelled by the charts issued by the Admiralty. These sheets are outline charts published 60 years ago.
Cheduba Strait and Coast of Ramree . . .	12	Cancelled by the Admiralty charts of the same part of the coast.
Port Jackson . . . . .	8	Cancelled by the new Admiralty charts.
Hainan, south-east coast . . . . .	17	Cancelled. Outline chart published in 1822. Sheets worn out.
China Coast, east of the Great Ladorne .	18	Cancelled. All wrong. Charts published 1813.
China Sea (Sheet 7) . . . . .	7	Cancelled. Very old and worm-eaten.
Coast of Arracan . . . . .	17	Cancelled by the new editions published by the Admiralty.
Quade Harbour, Persian Gulf . . . . .	17	Cancelled by the edition issued by the Admiralty. Charts old, untouched for 50 years.
China Sea (Sheet 4) . . . . .	5	Cancelled. Sheets useless, torn, and worm-eaten.

Title of Chart.	Copies.	Remarks.
South coast of China . . . . .	18	Cancelled. Outline map published 70 years ago. All wrong.
River Hooghly (Calcutta to Sangor Point)	13	Cancelled by new editions published since 1839.
Andaman Islands . . . . .	12	Cancelled. Sheets worn out. Copies in Office.
Bassein River . . . . .	14	Cancelled by new charts of the river.
Malacca Strait . . . . .	18	Cancelled by the charts published by the Admiralty.
Indian Ocean (north-west part) . . . .	11	Cancelled by the new Admiralty charts.
Persian Gulf . . . . .	18	Cancelled by Constable's and Stiffe's new charts.
Cochin Bar . . . . .	23	Cancelled by the Admiralty plan of Cochin. Copies in Office.
Canton River . . . . .	18	Cancelled by the Admiralty chart. These sheets are 60 years old.
North and north-west coast of Banka . .	16	Cancelled. Outline published in 1819. Sheets old and worn out.
South-east coast of Arabia . . . . .	17	Cancelled. Compasses and longitudes all wrong.
Chagos Archipelago . . . . .	17	Cancelled by the Admiralty charts. Sheets were 40 years old.
Bombay Harbour . . . . .	14	Cancelled. Sheets torn and useless.
Coringa Bay . . . . .	27	Cancelled by new surveys by Hammond. Copies of this old sheet in office.
African Coast . . . . .	26	Cancelled by new editions published by Admiralty.
Part of the coast of Arabia in the Persian Gulf . . . . .	18	Cancelled. Old outline charts published 50 years ago by the East India Company.
Gilloio Passage . . . . .	18	Cancelled by modern charts. Blakely's sketch chart published 55 years ago. Useless.
Chookiang or Canton River . . . . .	18	Cancelled by Admiralty charts now published.
Bays near Cape Aden . . . . .	17	Cancelled by the edition now published by the Admiralty.
Southern side of the Persian Gulf . . . .	18	Cancelled by Constable's and Stiffe's surveys. Charts torn and useless.
Arabia (south-east coast) . . . . .	6	Cancelled. Charts worm-eaten.
Port Louis (Mauritius) . . . . .	49	Cancelled. Admiralty edition of 1831. Superseded by later issue.
Gulf of Masseera . . . . .	1	Cancelled. Torn and useless.
North-east coast of Arabia . . . . .	1	Ditto ditto.
China Sea (Sheet 4) . . . . .	1	Cancelled by new edition published by Admiralty.
China Sea (Sheet 2) . . . . .	4	Cancelled by new edition published by Admiralty.
Gulf of Kutch. . . . .	2	Cancelled. Old edition superseded by new issue.
Kurrachee Harbour . . . . .	2	Cancelled. All wrong.
Passages leading to the Lymoon . . . .	17	Cancelled. Outline chart published by East India Company in 1830.
Maldiv Islands . . . . .	22	Kept; useful.
Coringa Bay . . . . .	10	Cancelled by new surveys. This is Fell's chart. Two copies kept for reference.
River Hooghly (Calcutta to Saugor Point)	26	Cancelled by Admiralty editions published since 1839.
Coast of Sind and Kutch . . . . .	8	Cancelled by Admiralty edition of the same part.
West coast of Ceylon . . . . .	69	Cancelled by Admiralty charts.
China Sea (Sheet 1) . . . . .	7	Ditto.
China Sea (Sheet 3) . . . . .	24	Ditto.
Gulf of Aden . . . . .	24	Cancelled. Longitudes and compasses wrong. Charts uncorrected for 30 years.
Physical chart of Indian and Chinese seas for every month of the year . . . . .	200	Twelve sets kept for reference, remainder cancelled.
China Sea (Sheet 2) . . . . .	26	Cancelled by Admiralty new edition. Shoals, &c., all wrong.
China Sea (Sheet 3) . . . . .	6	Cancelled by Admiralty new edition. Shoals, &c., all wrong.
Chittagong to Arracan River . . . . .	19	Cancelled. Worn out, and details of coast all wrong.
Cochin River . . . . .	22	Cancelled by the new Admiralty chart. Taylor's survey in 1858. Two copies kept for reference.



Title of Chart.	Copies.	Remarks.
North-east coast of Arabia . . . . .	20	Cancelled. Sheets worn out.
Gulf of Aden . . . . .	29	Cancelled. Longitudes and compasses in error. Sheets uncorrected for 25 years.
Gulf of Kutch . . . . .	18	Cancelled, old edition. Coast to north-west all wrong; compasses in error, &c.
Coast of Arracan . . . . .	17	Cancelled by the Admiralty edition of the sheet.
Karrachi Harbour . . . . .	1	Cancelled. All wrong.
West coast of India (Sheet 6) . . . . .	1	Cancelled. Not corrected for new rocks, &c., at Vingorla (old).
Islands west of Socotra . . . . .	1	Cancelled. Old edition published by East India Company.
Gulf of Aden . . . . .	1	Cancelled. Not corrected for 25 years.
Lakadive Islands . . . . .	4	Old and worn out.
Coringa Bay . . . . .	1	Ditto.
Maldiv Islands, one sheet . . . . .	2	One cancelled, worn out; the other good kept.
West coast of Ceylon . . . . .	3	Cancelled by Admiralty chart.
North-east coast of Africa . . . . .	2	Good. Can be issued.
Chittagong to Arracan River . . . . .	3	Cancelled by new edition of Admiralty charts.
Coast of Arracan . . . . .	3	Ditto ditto.
Coasts of Sind and Kutch . . . . .	30	Cancelled. Old East India Company's edition. Not corrected for 25 years.
Hooghly River (Calcutta to Sangor Point) . . . . .	1	Cancelled by new chart published by the Admiralty.
Gulf of Aden . . . . .	1	Old and worn out.
West Coast of India . . . . .	4	Ditto.
North-east coast of Arabia . . . . .	5	Old East India Company's edition. Cancelled by Admiralty charts.
China Coast (Sheet 4) . . . . .	9	Cancelled by the new edition published at the Admiralty.
Karrachi Harbour . . . . .	38	Cancelled by new editions, the bar all wrong.
China Coast (Sheet 1) . . . . .	21	Cancelled by the new edition issued at the Admiralty.
Gulf of Aden . . . . .	39	Cancelled. Old East India Company's publication. Not corrected for 26 years.
West coast of Ceylon . . . . .	33	Cancelled. Old East India Company's chart. Uncorrected for 30 years.
Physical chart of Indian and China Seas. China Sea (Sheet 4) . . . . .	48	Good. Useful for reference.
Gulf of Aden . . . . .	6	Cancelled. Old and worn out.
Gulf of Kutch . . . . .	25	Cancelled by the corrected edition published by the Admiralty.
China Sea (Sheet 6) . . . . .	3	Torn and useless.
China Sea (Sheet 3) . . . . .	4	Ditto.
Coast of Kattywar . . . . .	7	Copy of original survey by Whitelock, I. N., 1833. One copy retained for reference; the others were torn and useless.
Arafura Sea . . . . .	3	Cancelled by the new editions of the Admiralty charts.
Battnah or Burka Coast . . . . .	7	Sheets decayed. Not touched for 47 years.
Grand Port, Mauritius . . . . .	3	Cancelled. Old and worm-eaten.
Cape Agulhas . . . . .	8	Cancelled. Old edition of 1839. Superseded by new Admiralty charts.
North part of the Bay of Bengal . . . . .	3	Lloyd's survey (old lithograph), 1840. One copy kept for reference, the others destroyed.
Coast of Arabia . . . . .	15	Torn and worn out.
Africa (Sheet 5) . . . . .	5	Worm-eaten. Old edition long since cancelled by the Admiralty charts.
Sands and channels in the Hooghly . . . . .	1	Old edition. Sheet worn out and soundings all wrong.
Ambong Bay . . . . .	7	Cancelled. Torn and useless.
Cochin China (Sheet 1) . . . . .	6	Cancelled by new Admiralty charts, 30 years old.
Cochin China (Sheet 2) . . . . .	5	Cancelled. Long since superseded by Admiralty charts.
Coast of Kattywar . . . . .	16	Cancelled. Ethersey's survey, 1836 (only western portions of the sheet).
Labuan Island . . . . .	5	Cancelled. The 1st edition of the Admiralty chart. Uncorrected for 30 years.
East coast of Arabia . . . . .	18	Cancelled. Fifty years old.
East coast of China . . . . .	18	Cancelled. Blocland's sketch in 1827. Long since cancelled by the Admiralty surveys.

Title of Chart.	Copies.	REMARKS.
Api Point to River Sarawak . . . .	6	Cancelled. The Admiralty 1st edition. Untouched for 31 years.
China, Hong-Kong . . . . .	2	Cancelled. Uncorrected for 35 years.
Harlem's Bay and part of Chinese Coast.	18	Cancelled. Ross' sketch in 1812, superseded by Admiralty surveys.
Battnah or Burka Coast . . . . .	17	Cancelled. Useless. Uncorrected for 47 years.
Diu Harbour . . . . .	26	Cancelled by plan of Diu Harbour on Admiralty chart 2736.
China Sea (Sheet 1) . . . . .	5	Cancelled. Worm-eaten, 40 years old.
Sketches of Ports, Arafura Sea . . . .	6	Cancelled. Worm-eaten, 35 years old.
Ilchester's Shoal . . . . .	17	Cancelled. Sketch by Ross in 1819. Useless.
Cape of Good Hope . . . . .	3	Cancelled by new Admiralty plans. Sheets 50 years old.
Amphitrite Islands . . . . .	18	Cancelled. Old copies of Ross' charts published in 1808.
Bate Harbour, Kutch Gulf . . . . .	29	Cancelled. Jones' sketch, 1833, superseded by Taylor's survey. Two copies kept for reference.
Maldiv Islands . . . . .	20	Good. May be used.
Plan of the Appo Shoal . . . . .	18	Cancelled by new Admiralty charts. This is Ross' work in 1816.
Anjenwil Harbour . . . . .	17	Cancelled. East India Company's edition. Fifty years old. Worn out.
Amoy Harbour . . . . .	8	Cancelled by new Admiralty sheets. Charts uncorrected for 30 years.
China Sea (Plan of the soundings) . . .	15	Cancelled. Fifty-four years old.
Labuan Island . . . . .	7	Cancelled by new Admiralty charts.
West coast of Ceylon . . . . .	16	Cancelled by Admiralty charts.
Bass' Strait . . . . .	4	Cancelled by Admiralty new charts of the Strait. Sheets worn out.
Ava Coast (Calventuras to Diamond Island) . . . . .	11	Cancelled by the Admiralty edition of this sheet.
Malay Peninsula . . . . .	18	Cancelled. Horsburgh's edition of 1813 long since cancelled by Admiralty charts.
Ceylon, west coast . . . . .	17	Cancelled by Admiralty charts.
Chookiang, or Canton River . . . . .	34	Cancelled. This is the Admiralty 1st edition issued 31 years ago. Uncorrected for new surveys.
Coast of Ava (Sheet 2) . . . . .	18	Cancelled by the Admiralty edition of this sheet.
Chittagong River . . . . .	34	Cancelled. Lloyd's original chart superseded by new surveys of Pearson and Hammond. Two copies kept for reference.
Chagos Archipelago . . . . .	18	Cancelled by new edition published at the Admiralty (40 years old).
Gulf of Masseera . . . . .	37	Ditto ditto.
Coromandel Coast (from Point Calimere to Cape Comorin). . . . .	1	Not destroyed. M.S. map of coast issued from the Surveyor General's Office and signed by Montgomerie in 1829.
Adelaide Port and Holdfast Bay . . . .	8	Cancelled. Admiralty 1st edition superseded by later charts.
Peninsula of Korea . . . . .	8	Ditto.
Index to the charts (Coast of China) . .	7	Cancelled. All wrong.
Coast of Ava (Sheet 11) . . . . .	1	Cancelled by Admiralty edition.
Cochin Harbour and Roads . . . . .	10	Cancelled by Admiralty plan No. 65. It shews Moeresby's survey in 1835. Two copies have been kept for reference.
Ki San Sen Harbour . . . . .	18	Cancelled. Upwards of 60 years old.
Anchorage of El Katiff . . . . .	18	Cancelled. Horsburgh's chart 50 years old. Sheets worn out.
China Sea (Sheet 3) . . . . .	6	Cancelled by Admiralty new edition.
China Sea . . . . .	15	Cancelled by Admiralty new editions.
North-east coast of Australia . . . . .	7	Cancelled by the Admiralty charts. This is King's survey of 1819, and the sheets have been uncorrected for 53 years.
China Sea (Sheet 5) . . . . .	5	Cancelled by Admiralty new edition of the sheet.
Arafura Sea . . . . .	7	Cancelled. Worm-eaten, 41 years old.
Kyounk Phyou Harbour . . . . .	10	Cancelled by the Admiralty chart No. 831. Sheets eaten by cockroaches.

Title of Chart.	Copies.	REMARKS.
Kooria Moorla Bay and Island . . .	20	Cancelled by Admiralty edition of this chart. Sheets ragged and useless.
Gaspar and Clement's Straits . . .	18	Cancelled by the Admiralty charts of this Strait. These sheets were published 60 years ago and not touched since.
Coromandel Coast from Pulicat to Arma- gaon Hill . . . . .	15	Cancelled. Horsburgh's chart issued in 1822 and not since corrected.
Portion of Bombay Harbour . . .	16	Cancelled. Cogan and Peter's survey, 1829. Two copies kept for reference.
Straits of Durian . . . . .	18	Cancelled by the new editions published at the Admiralty. Charts untouched for 55 years.
Killon Harbour and Meropes Bay, Formosa	17	Cancelled. This is a sketch published 53 years ago, long since cancelled by new surveys.
Bassein River . . . . .	11	Cancelled by the new editions issued at the Admiralty.
China Sea (Sheet 8) . . . . .	8	Cancelled. (Admiralty edition of 1849.)
Dumrah River . . . . .	5	Kept. Useful for reference.
East coast of China, Gulf of Pechili, &c.	19	Cancelled by the new sheet issued at the Admiralty.
Ceylon, west coast . . . . .	17	Cancelled by Admiralty charts.
Part of the Mergui Archipelago . . .	6	Cancelled. This is the first edition of the East India Company's chart, and untouched for 48 years.
Cochin River . . . . .	10	Cancelled by the new edition published at the Admiralty.
Arroa Island (Straits of Malacca) . .	19	Cancelled by Admiralty sheets. These charts have been untouched for 58 years.
South coast of China . . . . .	18	Cancelled by new surveys and charts issued at the Admiralty.
Ceylon, west coast . . . . .	49	Cancelled. Superseded by the chart published at the Admiralty, No. 813.
North-east coast of Africa, neighbourhood of Cape Guardafui . . . . .	33	Eighteen good copies kept for reference.

## APPENDIX E.

*Memorandum on the reefs and dangers southward of Kundari Island, and the necessity for better marking those dangers by night, by NAVIGATING LIEUTENANT F. W. JARRAD, R. N., Deputy Superintendent of Marine Surveys.*

The dangerous reefs which lie at a considerable distance from the shore off Alibág together with the still greater danger to navigation, the "Chaul Kadu" Reef have lately been very carefully surveyed, and the coast between Kundari Island and Chaul charted by the officers of the Marine Survey Department.

Previous to the erection of Kundari Light, these very dangerous reefs were scenes of many a wreck, and between July 1864 and August 1866 (two years) no less than seven ships were wrecked between Kundari Island and the "Chaul Kadu" Reef. Since the light was lit (now 12 years), three vessels only have been wrecked in this locality, thus fully proving the great utility of this light to mariners making for the port of Bombay.

That there should, however, have been even three vessels wrecked so close to the light since it has been exhibited would point to the necessity for considering as to whether every possible means have been taken to guard against disaster and guide vessels clear of these dangerous reefs.

A glance at the new survey of the coast in the vicinity will at once show that this has not been done, for it will be observed that the light on Kundari Island is a *fixed* white light, which illuminates 225° of the horizon, between the bearings of N.-N.-W.- $\frac{1}{4}$ -W. and S. by W.- $\frac{1}{4}$ -W. (bearings from seaward). Thus the bright white light, which should be a guide to clear all dangers, shows over the whole of these reefs, and it also shows northward over another danger, *viz.*, the "Thull Shoal."

Now Kundari Light is the landfall light of the Port of Bombay, and while the bright white light is seen when standing towards the coast, it should be known that vessels are clear of danger. This, it will be seen, is not, however, the case at present.

To more effectually guard against wrecks occurring in this very dangerous locality, a *red* ray of light should be shown over the reefs and for some distance seaward of them. A vessel then on approaching too near these reefs by night, would be warned of her proximity to danger by the sudden changing of Kundari Light from *white* to *red*. The imminence of the peril thus being made clear, the necessity for *immediately* hauling off shore to sight the white light again would be unmistakeable.

In 1867, that is, before the light had been lit, the Trinity House (the most competent authority on the subject of lights) advocated the above, and proposed to throw a *red* ray over the Thull Shoal and reefs south of the island. The Trinity Board's proposition was as follows:— "Should show *red* (Kundari Light) to the northward between the bearings of N.- $\frac{1}{4}$ -W. and N.- $\frac{1}{4}$ -E. (bearings from the light) covering the Thull Shoal, and to the southward from S.- $\frac{1}{4}$ -E. eastward, covering the Chaul Kadu Reef."

I am not aware of the reasons which decided the Harbour and Pilotage Board on not carrying out the above good suggestion, but not very long ago, I believe, when it was again urged by Mr. T. Ormiston, C.E., I find that it was principally opposed by a former Deputy Conservator (Mr. Searle) on the grounds that a bearing of the light and the soundings are sufficient to guide vessels clear of danger.

It is difficult to believe that an educated nautical man would give such an opinion were it not understood that the Deputy Conservator had no special knowledge of such matters, whereas the Trinity Board and Mr. Ormiston may be considered experts; and it appears a pity that the opinion of the Deputy Conservator was allowed to overrule that of more competent authorities. The grounds advanced by the then Deputy Conservator for throwing over the proposition are quite untenable, for, in the first instance, the compass with which the bearing is taken *may be defective*; the chart also *may be incorrect* (and at the time the chart published by the Admiralty was terribly so, for until within the last year the Chaul Kadu Rock on which the beacon is built and the Alibág outer reef did not appear thereon), and without a *correct* chart to which to refer, the position of the ship cannot be ascertained by taking soundings. Strong tides, too, soon set a vessel into danger, and that imperceptibly, and therefore such means (taking a bearing and sounding) cannot be considered to be all that are required to ensure the safety of a ship; and if, indeed, such were the case, why are all the dangerous rocks and shoals in the vicinity of the large lights on the British and other sea-boards so marked by colored rays (*red*) thrown over them?

The time is now very opportune for making this addition to the safe navigation of the approach to Bombay, as the coast has been thoroughly surveyed and the positions of the dangers accurately determined. This shows that the Trinity House proposition requires slight modification in consequence of their not having had an accurate chart to refer to when considering the bearings between which they proposed to show a *red* light, so that instead of showing the *red* ray from S.- $\frac{1}{4}$ -E. (bearing *from* light) eastward, it would now appear better to show it from *south*, eastward over the reefs.

I believe the cost of inserting the red shade would be very small; Mr. Ormiston, I think, said about Rs. 500.

Captain Morland, the present Deputy Conservator of the Port, fully concurs in the desirability of carrying out this proposition and I also notice that the late Captain Henry, the able and experienced Superintendent of the Peninsula and Oriental Company, was also strongly in favor of it.





## APPENDIX F.

*A description of some new Species of Hydroid Zoophytes from the Indian Coasts and Seas, by*  
 SURGEON J. ARMSTRONG, *Medical Officer and Naturalist, Marine Survey Department.*

(With Plates IX, X, XI, XII.)

With the exception of a single species all the following hydroids are calyptoblastic. The one exception is *Endendrium ramosum*, which is a typical gymnoblastic zoophyte, and is especially remarkable in having the gonophores borne not upon a true blastostyle but upon atrophied hydranths from which the tentacles have disappeared.

*LAFOËA BLONGATA* (nov. spec.)

(Plate IX.)

*Zoophyte*.—Plant-like, gregarious, dark-brown.

*Trophosome*.—Stems erect, simple, straight or slightly curved, 1 to 2½ inches high, pinnate, with 3 or 4 transverse annular markings immediately above the origin of each pinna, and rooted by a creeping tubular stolon. The pinnae are alternate, and each carries on its upper surface a monoserial row of hydrothecae, they are transversely annulated, both at their origins from the stem and immediately above the origin of each calycle. The hydrothecae are free, elongated and tubular, annulated at their origins, and with the margin of the mouth even.

*Gonosome*.—Unknown.

*Habitat*.—Rocks between high and low water at Pigeon Island, and Konkan coast on the west coast of India, and at Diamond Island off the Pegu Coast in Burmah.

This very interesting form is certainly a campanularian, while its long tubular hydrothecae would indicate *Lafoëa* as its proper genus, a genus, however, not very well defined. I have lately had several opportunities of examining this zoophyte in a living condition; the polypites are supported on long attenuated peduncles, and have both disc and tentacles completely extruded from the hydrothecae, into the cavities of which they are only partially retractile. Although apparently tolerably extended in its distribution, it is very far from being abundant anywhere. It seems to thrive best in those localities most exposed to heavy seas and the influence of the South-West Monsoon. This species and another belonging to the genus *Thimaria* are the only representatives of the Hydroid family I have met with during two seasons spent upon the coast of the Ratnágiri and Alibág Collectorates.

*HALICORNARIA SETOSA* (nov. spec.)

(Plate X.)

*Zoophyte*.—Stiff, erect, solitary, and of a dark-brown colour.

*Trophosome*.—Stem bipinnate, more or less irregularly and numerously branched, varying in height from one to five inches, rooted by an entangled mass of short fibrous filaments, and carrying closely set primary pinnae. The main stem is made up of a fasciculus of three tubes, from the central one of which an alternate series of hydrotheca-bearing pinnae arises, but the stems of the secondary pinnae, which are formed of a fasciculus of two tubes, are destitute of hydrothecae, but carry along their entire length an alternate series of ultimate hydrotheca-bearing pinnae. The ultimate pinnae are thus borne not only on the primary pinnae but also on the stem; they are closely set, alternate, of nearly equal length, and divided by joints into a series of internodes, each of which gives origin to a calycle with its nematophores. The hydrothecae are deep, flask-shaped, deeply concave in front below the lip, and correspondingly convex behind; the aperture is wide, and has the margin provided with two large lateral teeth, and two smaller ones posteriorly. The nematophores are three in number, two lateral, which are short, blunt, divergent, and projecting slightly beyond the margin of the hydrotheca; and one mesial, which is remarkable as being provided with a lateral as well as terminal orifice, it is adnate to the base and lower third of the calycle, being free only at its extremity which projects horizontally outwards from the hydrotheca.

*Gonosome*.—Consists of a number of lozenge-shaped bodies filled with dark granular matter, and pointed at their free extremities; they arise on each side of the primary pinnae in the intervals between the ultimate pinnae.

*Habitat*.—Off Cape Negrais in 80 fathoms. At Cheduba Island in from 8 to 10 fathoms; off the Terrible Islands in 25 fathoms, and off Cape Comorin in 40 fathoms.

This beautiful species is closely allied to *Halicornaria bipinnata* of Allman. It has a very wide distribution, being found at intervals all along the Arrakan and Pegu coasts, as well as off the south coast of India. On several specimens which I examined, I found the main stem provided with two parallel rows of pellucid dots, the nature of which I have hitherto been unable to determine; they are, however, most probably the optical expression of cauline nematophores. It is also remarkable in having the mesial hydrothecal nematophore provided with a lateral orifice as in *H. saccaria* (Linn. Soc. Journ., Vol. XII.) This species appears to afford a favourite anchoring ground for a small bivalve belonging to the genus "*Vexillum*;" most of the specimens dredged up by me were covered with this species firmly adherent by their byssi and in different stages of development.

## HALICORNARIA PLUMOSA (nov. spec.)

(Plate XI.)

*Zoophyte*.—Feathery, gregarious.

*Trophosome*.—Stems one to two inches in height, fascicled towards the base, of a dark brown colour, straight or gently curved, minutely pinnate and rooted by a creeping filiform stolon. The pinnæ arise alternately by jointed processes from the anterior surface of the stem; they are divided by more or less complete joints into a series of short internodes, each of which carries a calycle with its nematophores. The hydrothecæ are unilateral and borne on the upper surface of the pinnæ and sessile; they are cup-shaped and have a large and patulous orifice, the margin of which is deeply denticulated, and is especially characterized by the possession of a single long mesial tooth immediately behind and projecting above the anterior nematophore. The intrathecal ridge passes backwards from the anterior nematophore across the lower fifth of the calycle and is prolonged into the wall of the pinna. The nematophores are only developed in connection with the hydrothecæ, they are three in number, two lateral and one mesial or anterior; the lateral are short, tubular, free and projecting; the mesial is long, adnate throughout its entire length, except at its immediate extremity, where it is free and slightly projecting.

*Gonosome*.—The gonothecæ arise singly from the posterior aspect of the stem near its base, they are bell-shaped and have a circular even and somewhat everted margin; the older ones present a more or less annulated or ribbed appearance.

*Habitat*.—In 35 to 40 fathoms off Cape Comorin, south coast of India, and in from 10 to 15 fathoms off Cheduba Island, coast of Arrakan.

## DESMOSCYPHUS HUMILIS (nov. spec.)

(Plate IX.)

*Trophosome*.—Stems gregarious, not exceeding a quarter of an inch in height, straight, simple, erect, divided by joints into a series of short internodes, each of which carries a pair of calycles, and rooted by a creeping stolon. The hydrothecæ are biserial, opposite, urceolate, the upper half free and tubular, the lower half adnate and sacciform; the aperture is directed upwards and outwards, and has the margin marked by several deep denticulations.

*Gonosome*.—The gonothecæ are broadly tubular or slightly pyriform and with a simple margin; they are opposite, and arise by short pedicles on each side in the intervals between the calycles with which they consequently alternate.

*Habitat*.—Saint George's Island on the west coast of India, attached to sea-weed between high and low water marks. This species is evidently referrible to the genus *Desmoscyphus* of Allman. (Linn. Soc. Journal, Vol. XII.) Although many gonangia possess clearly defined peduncles, yet at first sight some often appear to be sessile. This difference, however, is only apparent, for a closer examination shows that they are all pedunculated.

## SERTULARELLA RIGOSA (nov. spec.)

(Plate X.)

*Trophosome*.—Stems slender, arising at short intervals from a creeping filiform stolon, unbranched, zig-gag, and divided by constrictions immediately above each calycle into a series of rather lengthened internodes each of which supports only one hydrotheca. The hydrothecæ are biserial and alternate, they are broadly tubular, but wider at the base, where alone they are adnate, being narrower at the orifice, which is square, and has the margin produced into four nearly equidistant teeth, they are all more or less deeply annulated or spirally ribbed.

*Gonosome*.—Unknown.

*Habitat*.—Off Cape Comorin in 40 fathoms, and off the Arrakan Coast in from 10 to 15 fathoms.

This hydroid bears a very close resemblance to *S. tenella* of Alders, but differs from it in the stem not being twisted at the joints and in the spiral ribbing of the hydrothecæ.

## THIMARIA COMPRESSA (nov. spec.)

(Plate XII.)

*Trophosome*.—Stems sparingly clustered, about an inch and a half in height, unfascicled, erect, more or less decidedly zig-zag, rooted by a creeping tubular stolon, and giving origin to a limited number of pinnæ. The pinnæ are alternate, few in number, and arise at regular intervals from the main stem, of which they are for a short part of the commencement of their course mere diverticula, being identical with it in structure, destitute of hydrothecæ, and with two annular constrictions marking the origin of each. The terminal nine-tenths of its length is made up of an aggregation of closely packed subalternate hydrothecæ, which are continued to its termination. Very often, however, the pinna is composed of a linear series of two or sometimes of three of the simple forms above described. The lower half of the hydrotheca is broadly tubular and adnate, the upper half is narrower, free and projecting horizontally outwards, the aperture is oblique with the lower margin prolonged into a sharp tooth.

*Gonosome*.—Unknown.

*Habitat*.—Extremely abundant on the rocks between high and low water at Diamond Island, as well as amongst the laterite rocks on the Konkan Coast. I have also dredged it in 40 fathoms of water off Cape Comorin.



## ANTENNELLA ALLMANI (nov. spec.)

(Plate XII.)

*Trophosome*.—Stems sparingly clustered, very slender, gently curved from base to apex, rooted by slender filiform stolon, and attaining a height of about half an inch; they are divided by long, oblique partitions into a series of internodes, each of which carries an hydrotheca and four nematophores. The hydrothecæ are campanulate with large patulous orifices and perfectly even slightly everted margins. The nematophores are four in number on each segment of the stem, two lateral, one inferior and one superior. The lateral nematophores are quite free, long, narrow, and trumpet-shaped with a circular aperture and everted margin, from which they gradually taper down to extremely fine points, which are attached, one on each side, to lateral processes of the stem, by a joint which allows the slightest motion of the water to communicate free vibratory oscillations to the nematophore. The inferior nematophore is free, tubular, much shorter than the lateral, and arising from a tumescent prominence on the stem, slightly below the base of the calycle, is directed upwards towards its anterior aspect. The superior nematophore is somewhat smaller, but in form and direction corresponds precisely with the inferior, it arises on a level with the upper margin of the calycle from the stem, which is here quite even and presents no enlargement similar to that which marks the origin of the lower nematophore.

*Gonosome*.—Unknown.

*Habitat*.—Off Cape Comorin in 50 fathoms, and off the coast of Cheduba Island in 8 to 10 fathoms.

## ENDENDRIUM RAMOSUM (nov. spec.)

(Plate XII.)

*Trophosome*.—Tree-like, stem much and irregularly branched, attaining a height of  $3\frac{1}{2}$  or 4 inches, fascicular and rooted by an entangled mass of short fibrous filaments, the branchlets are more or less dichotomously arranged and are all annulated at their origins.

*Gonosome*.—Gonophores consisting of clusters of spherical bodies, filled with a granular substance. They appear not to be borne on true blastostyles, but on the bodies of atrophied hydranths from which the tentacles have disappeared.

*Habitat*.—In 40 fathoms off Cape Comorin, and very sparingly, in from 10 to 70 fathoms, along the coast of Arrakan.

## APPENDIX G.

*List of Charts, &c., issued at the Marine Survey Department, from April 1875, the date on which work was commenced at head-quarters, to 30th September 1879.*

## INDIAN OCEAN.

Office  
No. of Charts.

11. Indian Ocean, Curves of equal magnetic variation for 1877. By R. C. Carrington, F.R.A.S.

## PERSIAN GULF.

310. Bahrein Harbour Approaches. By M. Chapman, late I.N., 1874, 2 sheets.

## INDIA, WEST COAST.

15. Kurrachee to Vingorla. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876.  
15a. Vingorla to Cape Comorin. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876.  
25. Port of Serai. By Commander A. D. Taylor, I.N., 1879. (*In progress*).  
1217. Cutch Mandvi. By Commander A. D. Taylor, I.N., corrected to 1879.  
27. Veráwal Roads. By Lieutenants Constable and Stiffe, I.N., 1853, corrected to 1878.  
67. Bombay Harbour, showing the outer fishing-stakes. By Commander A. D. Taylor, I.N., May 1877.  
1231. Kundari Island to Chaul. By Navigating Lieutenant F. W. Jarrad, R.N., 1879. (*In progress*).  
1232. Chaul and entrance to Kundalika. By Navigating Lieutenant F. W. Jarrad, R.N., 1879. (*In progress*).  
39. Sketch of the entrance to Rajpur River. By Navigating Lieutenant W. P. Haynes, R.N., 1876.  
1233. Jaygad (Jyghur) and entrance to Shastri River. By Navigating Lieutenant F. W. Jarrad, R.N., 1879. (*In progress*).  
1234. Dabhol and entrance to Washishti River. By Navigating Lieutenant F. W. Jarrad, R.N., 1879. (*In progress*).  
1190. Ratnagiri, including Mirya and Kalbadavie Bays. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1878.  
1191. Rajapur Bay and Vizadurg with adjacent coast. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1878.  
43. Goa and Marmagao Roadsteads. By Commander A. D. Taylor, I.N., 1877.  
1176. Narakel Anchorage. Compiled from the latest Government Surveys, 1878.  
851. Quilon Roads. Lieutenant A. D. Taylor, I.N., 1858.

Office  
No. of Charts.

61. Lakadivh Group—Cherbaniani Reef, Chitlac and Kiltan Islands. Lieutenants Selby and Taylor, I.N., 1848.
53. Byramgore Reef or Chereapani, and Angria Bank. Lieutenants Selby and Taylor, I.N., 1848.
81. Kolachel Roadstead, with plan of Enciam Rocks. Surveyed by M. Chapman, I.N., 1875.

#### EAST COAST OF INDIA, BAY OF BENGAL, CEYLON, &c.

156. Cape Comorin to Coconada, including the Island of Ceylon. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876.
1218. Tuticorin Roadstead and Harbour. Surveyed by M. Chapman, I. N., 1879.
93. Approaches to Jafnapatam. Compiled from the latest Government Surveys, 1878.
95. Paumben Pass. Surveyed by M. Chapman, I.N., 1878.
1184. Approaches to Paumben Pass. Surveyed by M. Chapman, I.N., 1878.
- Cape Comorin to Cape Calimere. Compiled from various authorities. (*In progress.*)
1235. Mullaittivu or Moeletivoe. By J. Donnan, 1879. (*In progress.*)
1175. Colombo Harbour and its Approaches. Compiled from the latest Government Surveys, 1878.
1171. Approaches to Point de Galle Harbour, Ceylon. By T. H. Twynam and Commander A. D. Taylor, 1877.
- 103a. Bay of Bengal, Western Sheet. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1878.
- 103b. Bay of Bengal, Eastern Sheet. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1879.
104. Coromandel Coast. Sheet No. 2, from latitude 15° to 16° 30' N.
104. Sheet No. 3, from latitude 13° to 15° N.
104. Sheet No. 4. Lieutenant M. A. Sweny, I.N., 1859-60.
105. Madras Roadstead. Surveyed by Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1876.
1172. Orissa Coast, Narsapur Point to Palmyras Point, adapted to the latest determinations of the G. T. S., and observations by Commander A. D. Taylor, I.N. Compiled by R. C. Carrington, F.R.A.S., corrected to 1878.
- 15c. Coconada to Bassein River. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876.
113. Coringa or Coconada Bay, showing the Northern Godavery mouths. By Navigating Lieutenant G. C. Hammond, R.N., 1875.
109. False Point Anchorage. By H. A. Harris, 1875.
1165. False Point Anchorage. By Navigating Lieutenant G. C. Hammond, R.N., 1876.
117. Hooghly River—Luff Point to Anchoring Creek, showing the James and Mary Shoals and Entrance to the Roopnarain River. By Navigating Lieutenant Coghlan, R.N., 1875.
115. False Point to Mutlah River, showing the Approaches to Sandheads. From the latest Government Surveys. Compiled by R. C. Carrington, F.R.A.S., corrected to 1878. (*2nd Edition.*)
- 115a. Mutlah River to the Chittagong Coast. Compiled from the latest Government Surveys, 1879.
126. Chittagong or Kornafuli River. Surveyed by Lieutenant G. C. Hammond, R.N., 1876.

#### COAST OF BURMA, &c.

- 15d. Bassein River to Pulo Penang, including the Andaman and Nicobar Islands. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876.
134. Coronge Island to White Point, including the Gulf of Martaban. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., corrected to 1878.
137. Preparis North Channel and Entrance to Bassein River. By Commander A. D. Taylor I.N., and latest Government Charts, Compiled by R. C. Carrington, F.R.A.S., 1879.
143. Rangoon River Approaches. Surveyed by Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1876.
145. Entrance to Salween (Maulmain) River. Surveyed by Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1877.
151. Coast of Tenasserin—Tavoy River. From a Sketch by Lieutenant R. Moresby, with corrections and additions, by Commander A. D. Taylor, I.N., 1876.

#### SIAM, MALAY PENINSULA, WEST COAST.

1173. Hayes Island to the Pilgrims. Surveyed by Commander A. deRichelieu, Siamese Navy, 1877.
159. Kopah Inlet, from a Sketch by Commander A. D. Taylor, I.N., 1876.
1164. Salang Island (Junkseylon). Commander A. deRichelieu, Siamese Navy, 1876.
1163. Junkseylon, East Coast—Puket or Tonkah Harbour, by Commander A. deRichelieu, Siamese Navy, 1876.

#### GULF OF SIAM.

1177. Siam Gulf, West Coast, Hilly Cape to Lacon Bight. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872.

Office  
No. of Charts.

1179. Siam Gulf, West Coast, Lacon Bight to Lem Chang P'ra. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872.  
 1174. Patani Bay. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872.  
 1178. Singora Roadstead and Inner Harbour. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872.

## BOOKS, &amp;c.

- Return of Wrecks and Casualties in Indian Waters for the year 1876, together with a Chart showing the positions in which they occurred. Prepared by R. C. Carrington, F.R.A.S., Registrar of Wrecks.  
 Ditto ditto for 1877.  
 Ditto ditto for 1878.  
 List of Light-houses and Light-vessels in British India (Suez to Singapore), corrected from official information. By R. C. Carrington, F.R.A.S., 1879.  
 Spheriodial Tables, for every ten minutes of the quadrant, showing the length in feet of a degree, minute, and second of latitude and longitude; the corresponding number of statute miles in each degree of latitude; the number of minutes of latitude, or nautic miles contained in a degree of longitude under each parallel of latitude, and the length, in cables, of a minute of longitude, corresponding to each nautic mile. Compression  $\frac{1}{114}$ . By R. C. Carrington, F.R.A.S., 1877.  
 Glossary of French terms adopted on French Charts and Maps and in Sailing Directions. By R. C. Carrington, F.R.A.S., Marine Survey of India, 1879.  
 Catalogue of Charts, Maps, Plans, &c., in the Marine Survey Department, Calcutta. Compiled by R. C. Carrington, Marine Survey of India, 1879.

## HYDROGRAPHIC NOTICES.

## No.

1. Rangoon River. By Navigating Lieutenant F. W. Jarrad, R.N., 1876.
2. Mergui Archipelago. Cancelled; superseded by Notice No. 8.
3. Junkseylon and adjacent Islands. Cancelled; superseded by Notice No. 18.
4. False Point Harbour. By Navigating Lieutenant G. C. Hammond, R.N., 1876.
5. Koyouk Phyou Harbour. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1877.
6. Salween (Maulmain) River. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1877.
7. Approaches to Point de Galle Harbour. By Commander A. D. Taylor, I. N., 1877.
8. Mergui Archipelago. Pages 7 to 10 of this Notice; superseded by Notice No. 18.
9. Indus Banks and Kurrachee. By Lieutenant A. W. Stiffe, I.N., and the Master Attendant of Kurrachee, 1877.
10. Pamban (Paumben) Pass. By Morris Chapman, I.N., 1878.
11. Andaman Islands. By Navigating Lieutenant J. Tully, R.N., 1878.
12. Jiddah Harbour, Red Sea. By Commander W. J. L. Wharton, R.N., Her Majesty's Ship *Fawn*, 1878.
13. Red Sea, Navigation, Inshore passages. By the Hydrographic Office of the British Admiralty, 1878.
14. Red Sea. By the Hydrographic Office of the British Admiralty, 1878.
15. South Indian Ocean, Seychelle, Farquhar Islands, and Madagascar. By Commander W. J. L. Wharton, R.N., Her Majesty's Ships *Shearwater* and *Fawn*, 1875-78.
16. Torres Strait and New Guinea, South-East Coast. By Officers of Her Majesty's Ships employed on the Australian Station, 1878.
17. India, West Coast, Ratnagiri. Rajapur Bay and Viziadurg. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1878.
18. Coast of Siam, including Junkseylon and adjacent Islands. By Commanders A. D. Taylor, I.N., and A. de Richelieu, 1879.
19. Africa, East Coast, Pemba Island and adjacent coast. By Commander W. J. L. Wharton, R.N., Her Majesty's Surveying Vessel *Fawn*, 1878.
20. India, West Coast. The coast from Kundari Island to Chaul, and the harbours of Dabhol and Jaygad. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1879. (*Being prepared.*)

## NOTICES TO MARINERS.

*Notices to Mariners issued during the year 1875.*

- No. 1. Fixed Light on Green Island, Hong-Kong, China.  
 " 2. Malwan Rock, Malwan.  
 " 3. Fixed white Light at Dwarka, Kattywar.  
 " 4. Mooram Shulli Tivo Island, and Devil's Point, Gulf of Manaar.  
 " 5. (1) Fixed Light at Vizagapatam.  
 (2) Coral Shoal off Caltura, Ceylon.  
 (3) Rock off Barbeyrn Island.  
 " 6. Foundering of the Buoy Vessel *Mata Mata*, Rangoon.  
 Revolving Light near Acheen Head, Malacca Strait.  
 (2) Auxiliary Light to above.

*Notices to Mariners issued during the year 1876.*

- No. 1. Temporary discontinuance of Hope Island Light during repairs to Light-house column, Coromandel Coast.
- " 2. Exhibition of Hope Island Light, Coromandel Coast.
- " 3. Prohibited anchorage near the British Indian Coast Sub-Marine Telegraph Cable, Madras.
- " 4. Pulo Brasse auxiliary Light, Malacca Strait.
- " (2) Island between Pulo Nias and Sumatra.
- " 5. Vessels trading to Reunion, Indian Ocean.
- " 6. Replacement of the Buoy on the western edge of Dolphin Shoal, Chittagong coast.
- " 7. China Bakeer Light, Martaban Gulf.
- " (2) Intended exhibition of Light on the Oyster Reef.
- " 8. Fixed white Light at Verawal.
- " 9. Buoyage of Kyouk Phyou, British Burma.
- " 10. Fixed white Light at Bet or Beyt (Gulf of Cutch), Kattywar.
- " 11. Fixed white Light at Porbandar, Kattywar.
- " 12. (1) Displacement of the Buoy in Narakel Roadstead, Cochin.
- " (2) Buoy marking the smooth-water anchorage to the southward of Alipée (Anlapolay), Travancore.
- " 13. (1) Intended Light on Pulo Pisang, Malacca Strait.
- " (2) Sunken Reef in Siberoot Strait, Sumatra, West Coast.
- " 14. Deposit of stone mound at the end of the break-water, Colombo, Ceylon.
- " 15. Period of exhibition of the blue Light during the South-West Monsoon, Eastern Channel Light-vessel at the entrance to River Hooghly.
- " 16. Rock near west end of Pulo Brasse.
- " 17. (1) Beacon on two-fathom patch off Batticaloa Road, Ceylon.
- " (2) Suspension of Light at Vizagapatam.
- " 18. Directions for Kurrachee Harbour.
- " 19. Beacon on two-fathom patch off Batticaloa Road, Ceylon.
- " 20. Fixed Light at Calingapatam Point, Coromandel Coast.

The following Notices to Mariners were issued during the year 1877 :—

- " 1. Alteration in Manora Point Light, Kurrachee.
- " 2. Dangers at Goa and Marmagao Roadsteads.
- " 3. Existence of rocky patches, Beypore.
- " 4. Pooree Port limits, Orissa Coast.
- " 5. Extension of the Hajamri Mouth of the River Indus.
- " 6. Red Lights at Port Victoria, Mahé, Seychelles.
- " 7. Light at Port Berberah, Gulf of Aden.
- " 8. Rock off Hingie Island, Bassein River.
- " 9. Rock off Pegu Coast.
- " 10. Coral patch near Sultan Shoal, Singapore Strait.
- " 11. "Intermediate" Light-ship, entrance to River Hooghly.
- " 12. Position of Cochin Light-house.
- " 13. Position of Raleigh Rock, and additional beacons, Bombay.
- " 14. Buoy, marking Gindurah Rock, Galle.
- " 15. Alteration in Manora Point Light, Kurrachee; and discovery of a bank near Towak Island, Red Sea.
- " 16. Dangerous rocks in Forrest Strait, Mergui Archipelago, and Richelieu Rock off Kopah Inlet.
- " 17. Alteration in position of "Intermediate" Light-ship entrance to River Hooghly.
- " 18. Destruction of the Krishna Shoal Light-house.
- " 19. Correct position of Santipilly Light-house.
- " 20. Anchorage Buoys in Madras Roadstead.
- " 21. Light-vessel near Krishna Shoal, Burma.
- " 22. Additional information, Krishna Shoal Light-vessel and Light at Pooree.
- " 23. Alteration of position of Chittagong Lights.
- " 24. Night Signals shown by British Pilot Vessels in the English Channel.

*Notices to Mariners issued during the year 1878.*

- " 1. Position of Middle Ground, Bombay.
- " 2. Error in position of Krishna Shoal Light-vessel.
- " 3. New Lights in Sunda Strait, &c.
- " 4. Corrected position of Krishna Shoal Light-vessel.
- " 5. Alteration of color of Chittagong beacons, and intended alteration in Dolphin Rock Light, Bombay.
- " 6. Alteration of Malwan Light.
- " 7. Kintoon Light-vessel, Yang-tee-Kiang.
- " 8. Burgeus Rock off Hingie Island, Bassein River, Burma.
- " 9. Fairway Buoy at False Point, Orissa.
- " 10. Intended Light and Fog Signal on Little Bassees Rocks, Ceylon.
- " Intended alteration in Great Bassees Rocks Fog Signal.
- " 11. Corrected positions of Zebayir Islands, Zebel Zukur and the Hanish Islands, Red Sea.
- " 12. Fog Signals and distinguishing marks for Light-vessel, River Hooghly.
- " 13. Exhibition of Light on Little Bassees Rocks, Ceylon.
- " 14. Beacon on Chaul Kadu Rock, Bombay.
- " 15. Shoal near Tumb Island (Jazirat Tanb), Persian Gulf.
- " 16. Light at Batticaloa, Ceylon.
- " 17. Upper Gasper Light-vessel entrance to River Hooghly.
- " 18. Red Lights on North Groin of Harbour Works, Madras.
- " 19. Reported Shoal, N. N. E. of Bahrein, Persian Gulf.
- " 20. Alteration of colour of light at Klang Strait, Strait of Malacca—Salangore—Malay Coast.
- " 21. Additional information concerning the reported Shoal, N. N. E. of Bahrein.
- " 22. Deposit of stone, eastward of Harbour Works, Madras.
- " 23. Reported Shoal, North-West of Cheduba Island.
- " 24. Exhibition of blue lights and Maroons at Krishna Shoal Light-vessel.
- " 25. Deposit of Stone, Eastward of Harbour Works, Madras (additional information).
- " 26. Vessels prohibited from anchoring near the Sub-marine Telegraph Cable between Diamond Island and the Mainland.
- " 27. Intended exhibition of a Revolving Light at Vakalapudi, in the Godavery District.

*Notices to Mariners issued during the year 1879.*

- " 1. Permanent moorings for Eastern Channel Light-vessel, entrance to Hooghly River.
- " 2. Sunken danger in Mergui Archipelago.
- " 3. Revolving Light at Vakalapudi, in the Godavery District.
- " 4. Intended alteration in False Point Light.
- " 5. Shifting of the entrances to Honore (Honawar) and Mangalore, on the Malabar Coast.
- " 6. Fixed Light at Roji (Nowa Nugga) in the Gulf of Cutch.
- " 7. Fixed Light at the entrance to Toons Creek in the Gulf of Cutch.
- " 8. Fixed light at Gaspnath Point in the Gulf of Cambay
- " 9. Wreck marking vessels.

- No. 10. The alteration in the position and improvement of Pooree Port Light.
- " 11. Shoal Coral Ground in Strait of Banks.
- " 12. Delagoa Bay. Removal of Cockburn Light-vessel in bad weather.
- " 13. (1) Alteration in position of Beacons and Leading Lights—Burnett River Entrance, Australia.  
 (2) Fixed Light on Flap-Top Islet—Pioneer River—Rocky Islets.  
 (3) Revolving Light on Low Isles—Trinity Bay.  
 (4) Leading Lights at Cook Town—Endeavour River Entrance—Cook Harbour.
- " 14. Sunken dangers between Algnada Reef and Diamond Island—Bay of Bengal.
- " 15. Flashing White Light on Puysegur Point—New Zealand.
- " 16. Dangerous Rocks, N. N. W. and S. E. of the southernmost of the Brothers Islands—Andaman Islands.
- " 17. Australia—South Coast—Gulf of St. Vincent.  
 (1) Prohibited Anchorage near Telegraph Cable, Port Phillip.  
 (2) Buoys marking Battery Practice Range at Williams Town.  
 (3) Fixed and Flashing Light on North Reef.
- " 18. Longitude of the Time Ball, Calcutta, and of Saugor Light-house, River Hooghly.
- " 19. (1) Discontinuance of additional Light at Fourth Point—Sunda Strait—Java.  
 (2) Shoal in the Fairway to Batavia Road.  
 (3) Fixed Light on Meinder's Reef—Madura Strait.
- " 20. (1) Shoal ground westward of Durnford Point—South Coast of Africa.  
 (2) Distinguishing features marking the entrance to Tugela River.  
 (3) Ditto entrance to Umhloti River.
- " 21. Buoys off Carwar Harbour (Sedashigar).
- " 22. (1) Alterations in Lights at St. Paul and St. Denis, Réunion Island.  
 (2) Harbour Light at St. Pierre.
- " 23. Buoys off Carwar Harbour (Sedashigar).
- " 24. Buoys and Beacons, Zanzibar Harbour.
- " 25. Alteration of False Point Light—Coast of Orissa.
- " 26. Red Buoy marking smooth-water anchorage off Porcaud, Alleppey.
- " 27. Change in the anchorage limits of the port of Madras.
- " 28. Intended discontinuance of light at El-weg (Sherm Wej-h), Red Sea.
- " 29. Interval of intended exhibition of blue Lights and Rockets at False Point Light-house.
- " 30. Replacing bar Buoys in Cochin Harbour, and extinguishing the Light at Narrakel.
- " 31. Range of visibility of light exhibited from Krishna Shoal Light-vessel.

## APPENDIX H.

*Report by* COMMANDER A. D. TAYLOR, I. N., *Superintendent of Marine Surveys, on the result of his examination of the Phæton shoal and Alguada reefs.*

I have the honour to report the result of my examination of the Phæton Shoal and Alguada reefs, which has occupied me in the *Hugh Rose* for eleven days. I would premise that many discrepancies were found on all published charts. The shape and size of Diamond island and its outlying reefs were altogether faulty, whilst its south-west reef was altogether omitted. The important discovery was also made that the bearing of Alguada light-house from the Moidan Phya pagoda, was  $2^{\circ} 20'$  in error; and that, whilst the bearing of the light-house from Porian point was correct, the bearing of that point from the pagoda had the same error ( $2^{\circ} 20'$ ) on admiralty chart No. 152 of Prepara, North-Channel.

2. I have now taken angles at Moidan Phya pagoda, as also at a temporary staff on Porian point, at Diamond island flag-staff and Alguada light-house. Having also taken several sets of true bearings I can render the chart approximately correct, that is to say, the points and islands, reefs and headlands will be relatively right. Moreover, the submerged banks and reefs have been extensively sounded over, and navigators may have more confidence henceforth in the charts when corrected.

3. The error in Azimuth from Pagoda point involves the placing of Alguada light-house just 40 seconds on a south  $56^{\circ}$  west bearing from its present assigned position, and this lengthens the reef on that line; but the north-east tip of the central ridge, where the structure is built, is tolerably well depicted on the chart. The dry rocks of Alguada reef lie in 3 parallel ridges, of which the central is highest and forms an almost unbroken line north-east-by-east and south-west-by-west of about one mile in length. The light-house stands only 300 yards from the south-west end of the reef, and not in the centre, as hitherto depicted on the chart.

4. There is, moreover, good anchorage for vessels communicating with the light-house between December and April, to the eastward of it in 7 or 8 fathoms over a sandy bottom. Bring the light-house between west-and-west by north-and steer in for it till the summit of Hengie islands is over Diamond island flag-staff. At this anchorage the small basket beacon on the north-east tip of the light-house ridge will bear about north. During the South-West monsoon there is another anchorage, right under the lee of the reef, between the horns of the central and northern ridges of rocks, with the light-house bearing south-west, and the basket beacon about 2 cables off and bearing about south-by-west. Here you get 6 or 7 fathoms. The delineation of these anchorages on the chart involves the erasure of some rocks which are now represented as lying eastward of the light-house.

5. I have now to describe the water space between Alguada reef and Diamond island. It consists of a series of shoal rocky ridges with guts of deep water intervening. These ridges are echeloned in parallel lines from the reef towards the island, so as to render the navigation between the two exceedingly dangerous. Indeed, I may say that the entire passage, which is 8 miles broad, though apparently safe in some parts, should never be attempted by even a small vessel. Those ships, which may have heretofore passed through, certainly escaped marvellously. There is absolutely no safe channel. Towards Alguada the ridges lie north-east-by-east and south-west-by-west over the Phæton shoal, and nearer to Diamond island they lie about north-east-by-north and south-west-by-south. The spurs of rocks (sandstone) which radiate from the island itself take a more north and south direction.

6. The effect of this peculiar formation is to leave lanes of deepish water which lie nearly north-east and south-west. Now the winds hereabouts, throughout the whole north-east monsoon, say, from end of November till April, are generally at north, north-west seldom veering to the east of north, and only, as sea-breezes, backing to north-west. On a north-east-by-north course a sailing ship may possibly have passed close-hauled between two of the ridges safely, though in small water. Under similar conditions of wind she may have passed out on a south-west course. But I trust that no vessel will henceforth attempt this most dangerous passage.

7. The India Government Steamer *Hugh Rose* grounded on a ridge at the distance of  $2\frac{1}{2}$  nautic miles on a north-north-east (magnetic) bearing from the light-house, but drifted over the shoal in less than 10 minutes. A rocky head, above 5 feet under water, was plainly visible from her fore-castle, only 5 yards to the north-east of her, whilst we had  $3\frac{1}{2}$  fathoms on the starboard quarter and 12 feet in the starboard forechains. As her bow paid off when the gibbs were hoisted, and the vessel floated over the reef, this rock passed along her port side at the same distance. About one hundred yards eastward of the rock we had 9 fathoms.

8. Intermediate between the *Hugh Rose* rock and the Phæton shoal, or 3,500 yards from the former, and also bearing north-north-east from the light-house, another ridge presents a rocky head with only 16 feet at low water. This ridge is two miles in length north-east and south-west. When the sea-breeze blows, or when there is a current setting across these ridges, their long lines may be plainly perceived by the broken water.

9. The Phæton shoal has several rocky heads. We found 3 or 4 shoal lumps with depths of only 12 to 13 feet. The pilots inform me that their boat has touched at one spot in 6 feet. This shoal is nearly connected with Diamond reefs on the north; whilst a deepish gut, only

half a mile wide, separates it from the intermediate ridge mentioned in the last paragraph as lying northward of the *Hugh Rose* reef.

10. I would also point out here that, to the north-west of Diamond island, at the distance of 3 and 4 miles, there is a sand bank, which formerly had  $4\frac{1}{2}$  fathoms, but now has  $3\frac{1}{2}$  fathoms only. The fair channel into Bassein river from the northward used to pass between this shoal and Pagoda point. The course inward was about south-east  $\frac{1}{4}$  east towards the Fairway Buoy. But only vessels of light draught should now attempt it. The only really deep channel for vessels coming from the northward, is round the south side of this shoal, or about one mile to westward of Diamond island, with the red Buoy touching the south-east low extreme of Hengie island. The Fairway buoy may be steered for when it bears to southward of east.

11. Having described the dangers I will now state how we came to hit upon *Hugh Rose* rock. After sounding all round the Alguada reef, and for the purpose of taking up anchorage to eastward and thence visiting the light-house, we were leisurely at half speed proceeding round the north end of Alguada reef at a distance of  $2\frac{1}{4}$  miles, where the chart showed deep water, 21 and 29 fathoms, and where the native pilot assured us there was no known danger. We had no ground at 20 fathoms for several casts, then a cast of 9, then 6 and 4, as fast as the lead could be hove, immediately after which the steamer took the ground as described in paragraph 7. Mr. O'Brien, the Senior Pilot at Diamond island, obligingly lent me his steam launch for one day's sounding over the Phæton shoal.

12. In concluding this report I would bring to the notice of the Government of India that the officers of the *Hugh Rose*, Captain E. H. Fenn, and Messrs. J. Clarke, E. J. Beaumont, and J. Casey, have rendered me much cheerful assistance.

## APPENDIX I.

*Report by COMMANDER A. D. TAYLOR, I.N., Superintendent of Marine Surveys, on the inspection tours made by him, with the permission of the Government of India, during the season of 1878-79.*

2. In the first place I visited Chandbally, and having been requested by the Bengal Government to state how far the Dhumra river entrance required surveying and what means might be afforded to the Port Officer at Chandbally (Mr. Webster, who had served as Assistant on the Hooghly river survey for several years) to enable him to carry out a partial examination, I suggested that the Marine Survey Department should lend the necessary instruments; sextant, station pointer, compass, &c., were accordingly sent to Chandbally on 26th November 1878.

3. On 9th October, I proceeded to Bombay to meet Colonel Thomason, R.E., and Captain Baird, R. E., the former officer being associated with me for the purpose of considering the values of the several harbours of India, whilst Captain Baird and I had to select positions for tide gauges. In the course of November and December, partly by utilising the I. G. Steamer *May Frere* and otherwise by picking up the British India Steam Navigation Company's coasting steamers, we managed to inspect Carwar, Honore, Mangalore, Bepore, and Cochin.

4. Before the arrival of Colonel Thomason, and taking advantage of the *May Frere* not being then required by His Excellency Sir Richard Temple, I spent a few days in examining Bhaonagar channel, as reported in my letter marginally noted.

No. 84 (Surveys), dated 24th December 1878. The result of this examination will be published as soon as practicable. The Executive Engineer of Bhaonagar, by direction of His Highness the Thakore, has since been extending the survey operations to the new dock and the town itself. When his work reaches me I shall be able to issue a chart of the river. His Highness also cordially agreed to my proposal that his Engineer should procure from England and erect a self-registering tide-gauge of Captain Baird's pattern near Bhaonagar light-house; this will prove of great value when the re-survey of the Cambay gulf is taken in hand.

5. Previously to returning with the *May Frere* to Bombay I visited Jageshwar, having been requested by the Bombay Government to consider its fitness as a starting point for a steam ferry across the Cambay gulf.

6. In the month of January 1879, the Steamer *Margaret Northcote* being available at Tuticorin after undergoing protracted repairs at Bombay, Colonel Thomason and I proceeded from Calcutta to Madras and Tuticorin and thence to the Paumben channel. Finding that Mr. Chapman's late survey of the pass did not extend far enough eastward to meet the Colonel's views with reference to a great ship canal, and as bad weather was absolutely hindering the completion of the outer soundings at Tuticorin, I directed Mr. Chapman to return to Paumben with his steam-cutter and extend his sounding operations to the eastward as required. With the aid of the *Margaret Northcote* he was able to do this in the month of February, afterwards returning to Tuticorin and completing the survey thereof. The drawing of the additional surveyed area—which comprises two more miles, both to northward and southward of the coast of Rameswaram island, and many more soundings—is being got up in the Drawing Branch, and a copy of this will be supplied to Colonel Thomason.

7. On the 1st February I proceeded from Madras to Rangoon; there, according to previous arrangements with the Marine Department, the I. G. Steamer *Hugh Rose* awaited my arrival. I took that vessel to the Krishna Shoal, across which I ran several lines of soundings. This examination satisfies me that the shoal remains of much the same form as depicted on the chart. The I. G. Steamer *Ava* is said to have sounded all round the spot very shortly after the screw pile light-house was missed, and it was officially reported then that the soundings taken gave a depth of 6 fathoms all round at low water.

8. I found no such depth anywhere near. The *Star* light-vessel is anchored 4 miles to the eastward of the position formerly occupied by the light-house. She is in  $4\frac{1}{2}$  fathoms at low water of spring tides. The *Hugh Rose* sounded away from the *Star* on two lines, firstly, north-west-by-west- $\frac{1}{2}$ -west, on which course at half a mile off we had 4 fathoms (reduced), thence the water gradually shoaled till at  $2\frac{1}{2}$  miles the depth was 10 feet (reduced); this was the shoalest water found and the breadth of it was only 100 yards; afterwards the water gradually deepened till at  $1\frac{1}{2}$  miles further on the same course, we had  $4\frac{1}{2}$  fathoms (reduced); this was in the well-known channel between the shoal and the shore.

9. The second course we steered from the light-vessel was west-south-west. Near the vessel we had  $4\frac{1}{2}$  fathoms (reduced), thence gradually shoaling we had 3 fathoms at 3 miles off and  $2\frac{1}{2}$  fathoms at 4 miles from the *Star*. This least depth (15 feet) was maintained for 10 minutes, which proves that the shoalest south part of the Krishna is nearly a mile broad. At  $5\frac{1}{2}$  miles from the *Star* we had 3 fathoms, and at  $7\frac{1}{2}$  miles we again deepened to  $4\frac{1}{2}$  fathoms. From this last position we stood on the same course west-south-west but did not get 6 fathoms (reduced) till we were 10 miles from the light-vessel.

10. I firmly believe that search was not made at the right spot neither (from what I hear) was it made by the right method. Moreover, I think it very likely that a few days'



search with the *Hugh Rose*, next January or February, might result even at this late date in our hooking some portion of the submerged structure.

11. From the Krishna Shoal I took the *Hugh Rose* to Diamond Island, and after 11 days hard work, we obtained data for bringing out a new chart of the neighbourhood of Phaeton shoals and Alguada reefs. This chart is now ready for publication. In my letter as per margin I have already submitted some details concerning these reefs and the discovery of dangerous rocks.

12. From Diamond Island I proceeded to Port Blair (Andamans), at which place Colonel Thomason and Captain Baird had arranged to meet me, and did meet me, on the 24th February. There Captain Baird fixed upon a site for a tidal station. On the 27th we all proceeded in the India Government Steamer *Hugh Rose* to Mergui. Having there also selected a site for a self registering tide gauge, we went on to Maulmain. At Maulmain town, and also at Amherst by the Salween river mouth, tidal stations were selected. Afterwards we went to Rangoon river where a similar inspection and selection were made. At Rangoon I discharged the *Hugh Rose* which vessel then proceeded to Maulmain to be docked and repaired.

13. At Diamond Island and also at Bassein Captain Baird and I again took notes of spots where eventually tide gauges may be advantageously set up. Kyouk Phyoo and Akyab were the last prospective tidal stations we examined on this tour. From Akyab we proceeded in the British India Steam Navigation Company's Steamer *Commilla* to Calcutta, where we arrived on the 21st March.

14. In my letter No. 84 (Surveys), dated 24th December 1878, I pointed out how the wishes of the Bombay Government, with regard to the examination of the ports of Seraia and Kutch Mandvi, could be met if the *May Frere* were again placed at my disposal for a few days. The Secretary to the Government of Bombay in the Marine Department subsequently informed me that the vessel could be again lent in the beginning of April, subject to the contingency of her being required to take His Excellency the Governor to Carwar about that time.

15. Proceeding to Bombay on 5th April I found that the *May Frere* was still being utilised by the survey party under Lieutenant Jarrad, R.N., who had only received her on 20th March instead of (as previously anticipated) about the middle of January.

As it would have been very detrimental to the interests of the important Marine Survey off Chaul and Kenery which was being conducted by Lieutenant Jarrad (and which, I may add, has since been brought to a satisfactory completion), I deemed it advisable to forego the advantage of proceeding to Kutch Mandvi in the *May Frere*, and I therefore took passage to that port in the British India Steam Navigation Company's Steamer *Vingorla*.

16. I may here mention that a chart of Verawal had been compiled in this Department but could not be published till the positions of the new light-house and new piers (in course of construction) had been determined. Calling at Verawal in the S. S. *Vingorla* I had the opportunity of obtaining this most important information, and by sounding in the roadstead I discovered some dangerous patches of rock outside the port. The chart is now being phot zincographed.

17. With regard to Mandvi, I have to state that it had been reported to me by several British India Commanders that there was something radically wrong in the only published chart of the place regarding the relative positions of the principal landmarks. Owing to these representations I gave directions to Mr. Carrington that, from the records in my office, a chart of the approaches to Mandvi should be compiled on a large scale, and in the course of this compilation it was discovered that Assar Pagoda was about half a mile out in latitude on the only officially published chart. This error had crept in in some unaccountable manner when the general chart was compiled by the late Mr. John Walker, Geographer to the East Indian Company, and strange to say the mistake has existed undiscovered for twenty-five years. The Hydrographer's attention will be called to this. Whilst at Mandvi I took observations to test the triangulation of the larger-scale originals from which our chart is compiled, and being satisfied of their accuracy, our new chart will be published immediately. On this visit I was also able to ascertain the extent to which the Albert Edward breakwater at Mandvi had been carried and what alterations had taken place at the entrance of the creek since the construction of these harbour works. I visited the light-house and made suggestions to the Executive Engineer as to the necessity of carrying off from the burners the smoke which is now in a great measure confined within the lantern and blackens the glass-panes thereby, tending towards the morning to dim the brilliancy of the light.

18. Having inspected Mandvi, I sailed across the Gulf in a small hired native vessel and examined Seraia bunder, where I learnt that the operations of the Great Trigonometrical Survey had extended to this place only a few months before. If a tracing of their work can be furnished me, I shall be able to improve the shore features of the preliminary chart of Seraia which I have had prepared in this office for publication. I was enabled to make several additions and corrections to the original chart and collect information regarding tides, besides satisfying myself that, by means of two small light-houses and a few buoys, the approach to an excellent harbour might be made perfectly easy all the year round to vessels of the largest size and at all times of tide. My report on this place and Kutch Mandvi will be submitted when the new charts are ready.

19. It will thus be seen that I have carried out the inspection of the ports alluded to in paragraph 27 of the minute by His Excellency the Governor of Bombay, dated 11th September 1878. But, in addition to the above, the Bombay Government, in a Public Works Resolution

Proceedings of Government,  
No. 2109 of 1878, (Railways),  
dated 15th October, 1878.

as per margin, requested Colonel Thomason and myself to examine and select the best of two or three places whence it was proposed to start a steam ferry from either the Surat or Broach coast to Gogo or Bhaonagar in Kattywar. One of these places (Jageshwar) had already been visited by me in October last (as mentioned in paragraph 5), but I did not receive the letter containing the further wishes of the Bombay Government till my return to Bombay with the *May Frere* on 1st November. Then Colonel Thomason informed me that he was instructed by Sir Andrew Clarke to postpone his visits to all the minor ports and only to inspect the more important harbours at present. This question therefore regarding the best site for a steam ferry—so far at least as any consultation between myself and Colonel Thomason or my actual inspection of any of the places recommended as a terminus on the Guzerat shore (except Bhagwardandi and Jageshwar) is concerned—remains in abeyance. However, I have submitted to the Bombay Government my own decided preference of the village of Karanj, near Bhagwa, but at the mouth of Kantiajal-kari, as the most likely position for the Guzerat terminus.

20. From Bombay I returned to Calcutta *via* Madras, wishing to settle by actual inspection the position of the new Vakalapudi light at Cocanada, and to gain more information about Vizagapatam and False Point. These two last places I had been prevented from visiting in company with Colonel Thomason and Captain Baird in the beginning of February when I had to cross over from Madras to Rangoon to meet the I. G. Steamer *Hugh Rose* at the appointed time. My final return to Calcutta from all the above tours was on the 18th May.

Statement shewing the cost of the Marine Survey Department from the 1st April 1878 to the 31st March 1879, inclusive.

PARTICULARS.	Amount of each item.	Total of each heading.
<b>OFFICE OF THE SUPERINTENDENT OF MARINE SURVEYS.</b>	<b>Rs. A. P.</b>	<b>Rs. A. P.</b>
Superintendent of Marine Surveys ... ..	21,600 0 0	
Superintendent, Compiling and Drawing Branch ... ..	10,433 5 3	
Office Establishment ... ..	8,585 14 2	
		40,619 3 5
<b>CONTINGENT EXPENSES.</b>		
Office contingencies including instruments, books, &c. ... ..	4,934 4 2	
Travelling and halting expenses during inspection journeys ... ..	2,730 4 4	
House rent paid to Superintendent, Compiling and Drawing Branch ... ..	1,095 0 0	
		8,759 8 6
<b>SCIENTIFIC OFFICERS.</b>		
Scientific Officers ... ..	40,837 5 9	
Medical Officer and Naturalist ... ..	5,300 0 0	
House rent and conveyance allowance to Surveyors ... ..	406 14 0	
Field allowance of Surveyors whilst absent from Calcutta on surveying duties ... ..	12,197 8 0	
Travelling allowance of Surveyors to and from the surveying grounds ... ..	1,979 6 11	
		60,221 2 8
<b>No. 1 (BOMBAY) PARTY.—STEAM CUTTER "Girdlestone."</b>		
Wages of crew ... ..	5,401 6 11	
European and Native provisioners ... ..	1,118 4 0	
Contingencies ... ..	925 4 6	
Stores ... ..	1,160 11 9	
Repairs ... ..	97 5 10	
Passages of crew ... ..	28 1 0	
		8,731 2 0
<b>No. 2 (MADRAS PARTY.—STEAM CUTTER "Greenwich."</b>		
Wages of crew ... ..	4,989 9 1	
European and Native provisioners ... ..	841 7 9	
Contingencies ... ..	906 14 4	
Stores ... ..	372 1 7	
Repairs ... ..	511 4 9	
Passages of crew ... ..	942 6 11	
		8,563 12 5
Charges incurred in the Bombay Dockyard and debited to the Marine Survey Department, on account of the surveying steamer, "Investigator" building in the Dockyard ... ..	27,547 2 1	
		27,547 2 1
<b>MISCELLANEOUS CHARGES INCURRED BY OTHER DEPARTMENTS AND DEBITED TO THE MARINE SURVEY DEPARTMENT.</b>		
Cost of driving the silver nail into the surveying steamer "Investigator" ... ..	400 0 0	
Printing notices to Mariners, &c. ... ..	326 18 0	
Cost of charts photozincographed at the Surveyor General's Office ... ..	2,989 0 0	
Stationery and drawing materials ... ..	675 8 6	
Surveying instruments and repairs thereof ... ..	1,374 7 0	
		5,765 12 6
<b>TOTAL RUPEES</b> ... ..	<b>...</b>	<b>1,60,207 11 7</b>

A. D. TAYLOR,  
Superintendent, Marine Survey of India.

## K.

Statement shewing the cost of the Marine Survey Department from the 1st April to the 30th September 1879, inclusive.

PARTICULARS.	Amount of each item.	Total of each heading.
<b>OFFICE OF THE SUPERINTENDENT OF MARINE SURVEYS.</b>	<b>Rs. A. P.</b>	<b>Rs. A. P.</b>
Superintendent of Marine Surveys ... ..	10,800 0 0	
Superintendent, Compiling and Drawing Branch ... ..	7,809 10 11	
Office Establishment ... ..	4,690 11 6	
		22,800 6 5
<b>OFFICE CONTINGENCIES.</b>		
Office contingencies including the cost of charts almirahs, &c. ...	3,815 12 2	
Travelling and halting expenses during inspection journeys ..	1,394 0 0	
House rent paid to Superintendent, Compiling and Drawing Branch	552 0 0	
		5,261 12 2
<b>SCIENTIFIC OFFICERS.</b>		
Scientific Officers ... ..	17,959 5 2	
Medical Officer and Naturalist ... ..	3,454 13 5	
Field allowance of Surveyors whilst absent from Calcutta on surveying duties ... ..	5,865 0 0	
Travelling allowance of Surveyors to and from the surveying grounds	93 12 0	
		27,372 14 7
<b>No. 1 (BOMBAY) PARTY.—STEAM CUTTER "Girdlestone."</b>		
Wages of crew ... ..	2,209 6 10	
European and Native provisioners ... ..	504 8 6	
Contingencies ... ..	459 13 9	
Stores ... ..	53 15 2	
		3,227 12 3
<b>No. 2 (MADRAS) PARTY.—STEAM CUTTER "Greenwich."</b>		
Wages of crew ... ..	2,524 7 4	
European and Native provisioners ... ..	333 9 0	
Contingencies ... ..	581 14 0	
Repairs ... ..	196 8 0	
Passages of crew ... ..	650 8 0	
		4,088 14 4
<b>MISCELLANEOUS CHARGES.</b>		
Special allowance to the widow of an Officer to enable her to proceed to England ... ..	1,000 0 0	
		1,000 0 0
<b>TOTAL RUPEES</b> ... ..		63,751 11 9

A. D. TAYLOR,  
Superintendent, Marine Survey of India.





